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**Department of Water Resources
QA/QC Study
Characterization of Organic Carbon by
Ultraviolet Absorbance
Spectrophotometry**

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Principal Investigator**

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With the assistance of

Marvin Jung Technical Consultant

Background

- Organic Carbon levels have been measured for in the Delta for many years. It is suspected that peat soils, characteristic to the Delta, are a major contributor of organic carbon in surface waters. Other contributors include diffusion from sediments, and releases by phytoplankton and bacteria.
- Organic Carbon fractions in surface waters pertaining to this study can be grouped into:
 1. Biodegradable Organic Compounds (e.g. Polysaccarides) single bonded and readily break down in the environment
 2. Less Biodegradable Organic Compounds (e.g. Humic and Fulvic Acids) double bonded and highly stable
- It is the less biodegradable organic compounds that are of interest to this study.
- It has been established that surface waters containing organic carbon, when chlorinated at water treatment plants, result in disinfection byproducts, including Trihalomethanes. Some species of trihalomethanes are considered to be carcinogenic.
- Background reference material for this study was obtained from Three Approaches for Characterizing NOM, by Stuart W. Krasner et al, and Organic Substances and Sediments in Water, edited by Robert A. Baker.

Study Goals

- To determine the sources and levels of organic carbon that enter the Sacramento/San Joaquin Delta.
- To characterize organic carbon through spectrophotometry; specifically utilizing UVA scanning techniques.
- To use data gathered from Sacramento/San Joaquin Valley watersheds, which supply the Delta, to determine where to direct the Department's efforts to address organic carbon loading using best management practices for source surface water control.

Equipment/Methods

- A Hach DR/4000 Spectrophotometer was used to scan for UVA at wavelengths between 200 and 500nm.
- The instrument is equipped with a “flow through” module which facilitates multiple scans.
- The specific wavelengths of interest are at 254 and 285nm. The humic fraction of organic matter has been recognized to peak at an absorbance level of 254nm. Fulvic acids are thought to absorb at 285nm.
- Values for Specific UVA are calculated using absorbance values at 254 and 285nm, dividing them by DOC levels obtained from laboratory analyses and multiplying them by a factor of 100.
- Data is transferred to a computer data chart using the Hachlink software package.
- The data is transferred to Microsoft Excel, and charts are constructed which indicate scanned wavelengths in a graphic format.
- The natural log is then calculated and charts are constructed to indicate graphs that normalize variability around a mean.
- Once variability has been accounted for, a value for slope is obtained. From the slope values, geographic and temporal comparisons can be made for surface water samples.

- Mineral Samples: In addition to scanning for organic carbon, mineral data analyses are performed to serve as a tool to verify mixing ratios of water in the channels. Samples are taken at three sites along the DMC and compared to streams that feed the San Joaquin River and the San Joaquin as it enters the Delta. Subsequently, Bromide has also been sampled for on the Kesterson run for the past three sample events.

Quality Assurance/Quality Control

- The DR4000 Spectrophotometer was calibrated for this study by zeroing at the start of each scanning session. For calibration purposes, project personnel utilized the procedures outlined in the Hach UVA 254 scanning method for organic carbon which calls for organic free water.
- A baseline scan was then run on distilled (DI) organic free water samples at the start of each session following calibration.
- Samples of DI organic free water were then scanned to establish a signature for organic carbon in water that presumably contained none. These DI water scans were run at the start and end of each sampling run for quality control comparison.
- Duplicate samples were taken for DOC and mineral samples. RPD's were calculated for duplicate samples.
- Duplicate UVA scans were also run for each sampling event for purposes of comparison.

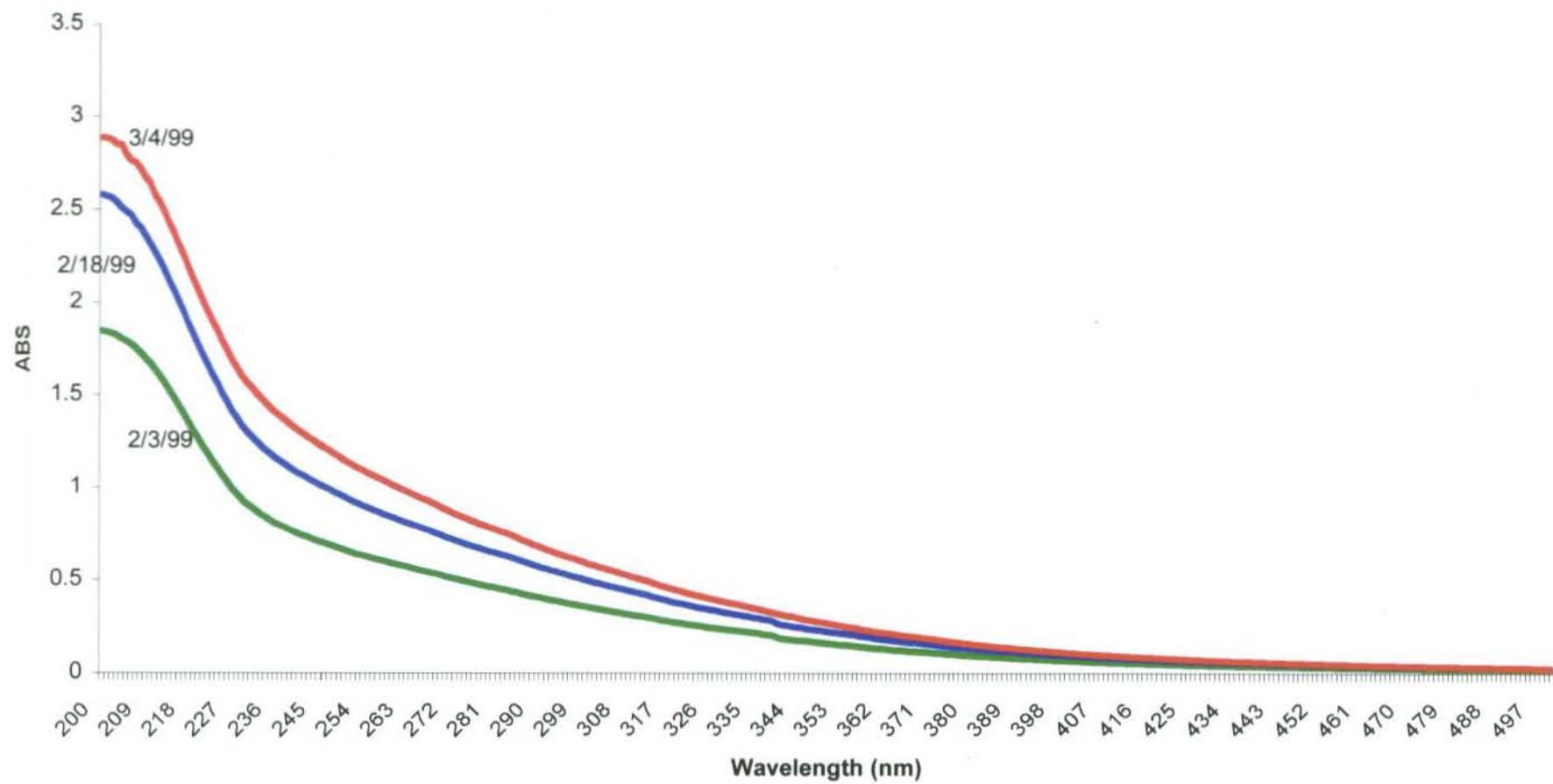
Preliminary Conclusions

- Samples that were scanned from regions with high natural organic matter (the Delta) had higher levels of absorbance.
- Samples that contained less organic carbon tended to have a more pronounced curve between 200 and 500 nm absorbance. The higher absorbance lines tend to become more linear.
- SMARTS data tend to confirm the effects of peat soil in contributing high levels of organic carbon to surface waters.
- Agricultural drains and creeks running through agricultural areas tend to have qualitatively higher levels of absorbance.
- Rivers flowing into the valley from the Sierra, such as the Yuba and the Merced, show qualitatively low absorbance levels.

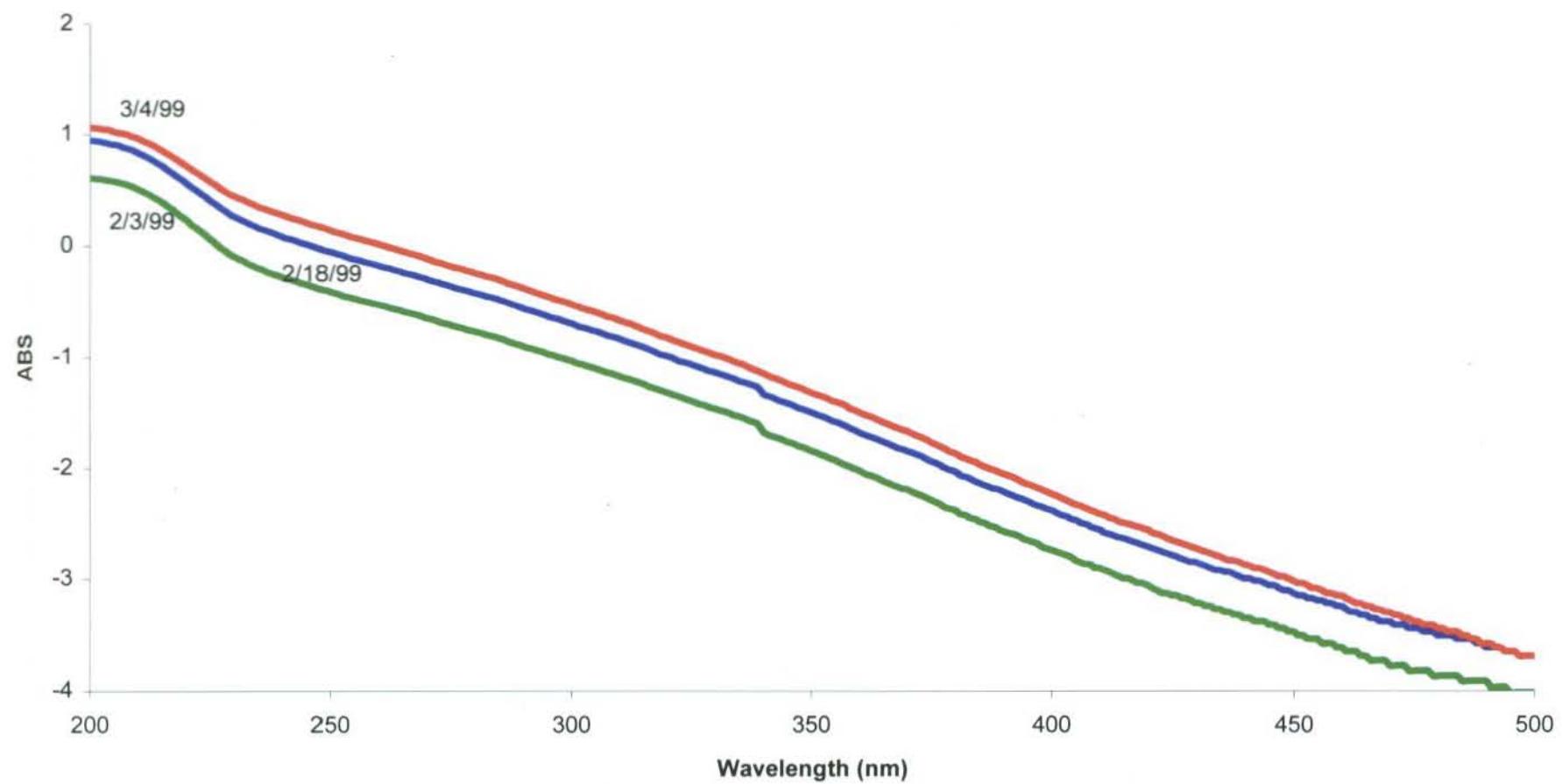
Study Continuation/Completion

- The first phase of the UVA study is now complete. We have data covering one year from most Delta and UVA study sites.
- Data from the SMARTS Program has been qualitatively evaluated first because of the projects controlled environment.
- The next step will be to evaluate the data from two or three strategic sample sites to create a model for the rest of the data.
- To analyze the data, the hydrology of the area in question and the flow rate at the time of sampling must be incorporated. This information is generally available from CDEC and the USGS website.
- Comparison of results with “baseline” absorbance graphs may yield answers to the origins of particular types of organic matter.
- A literature search is currently under way to obtain references for the final report.
- A table of contents for the draft report is currently in the works.

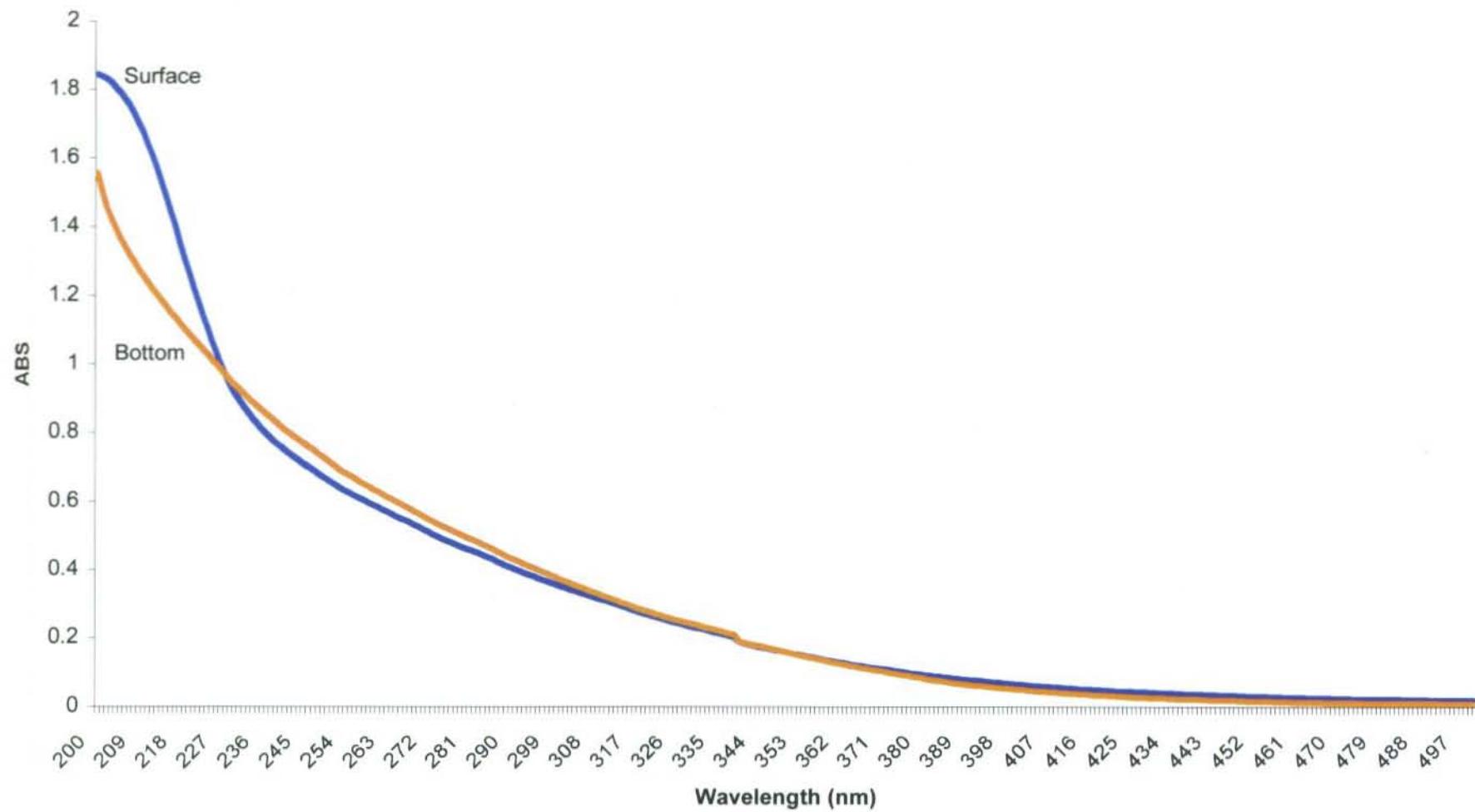
SMARTS Tank 1
Surface Water Comparison
Peat Depth: 1.5 ft
Water Depth: 2 ft
Flow: low @ stagnant



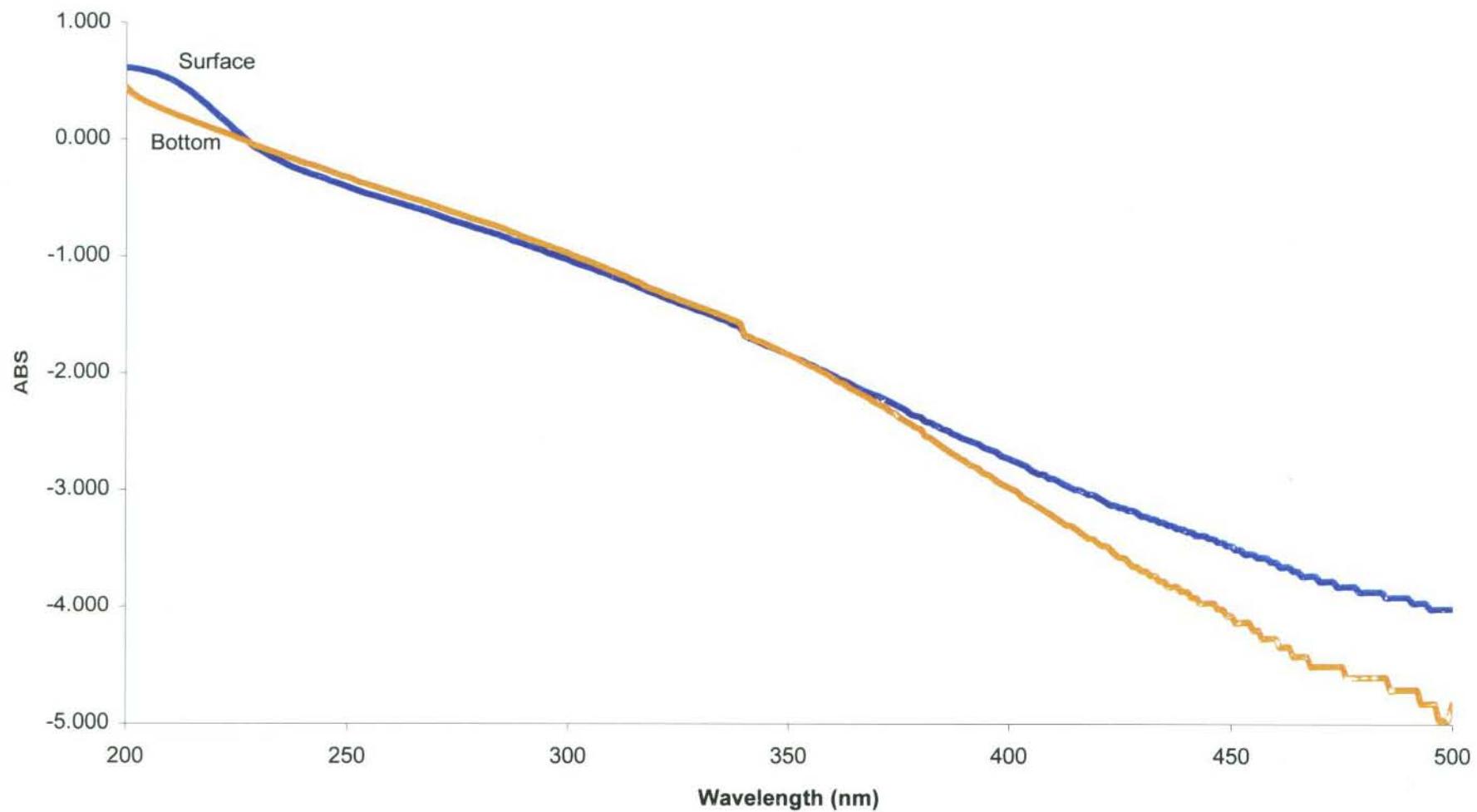
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Surface Water Comparison
Peat Depth: 1.5 ft
Water Depth: 2 ft
Flow: low @ stagnant



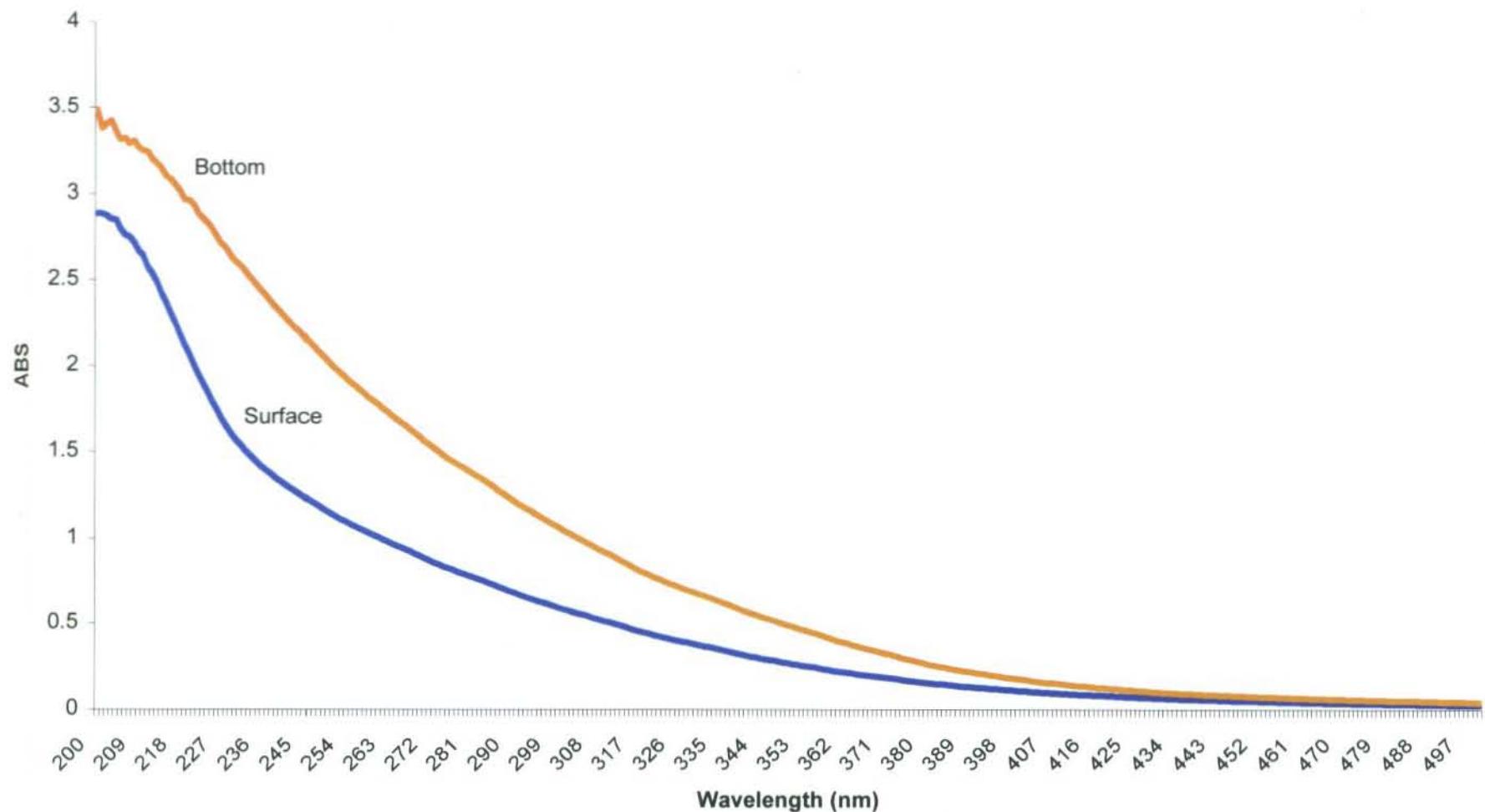
Tank 1
Surface to Sediment Sample Comparison
2/3/99



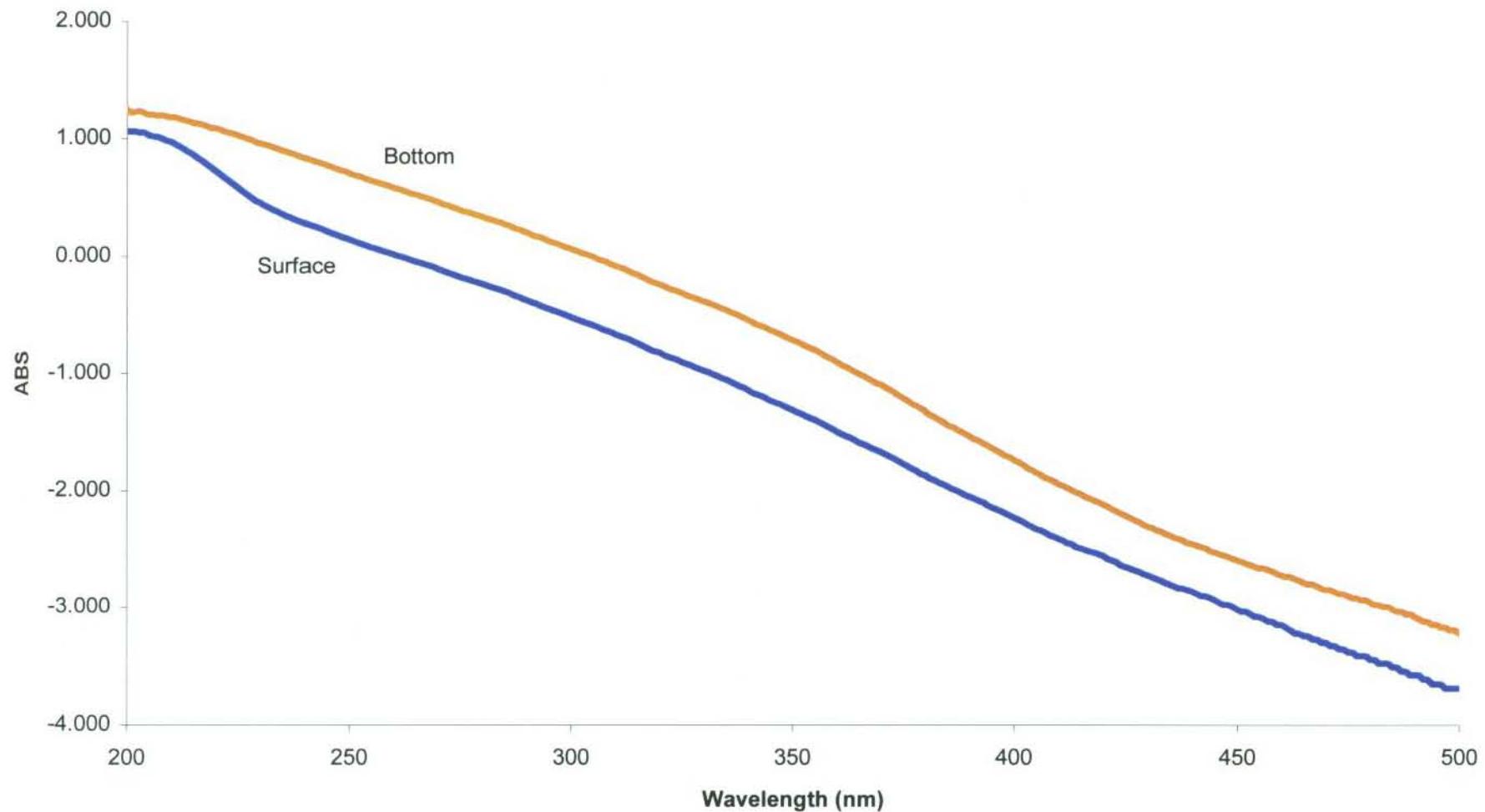
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2/3/99



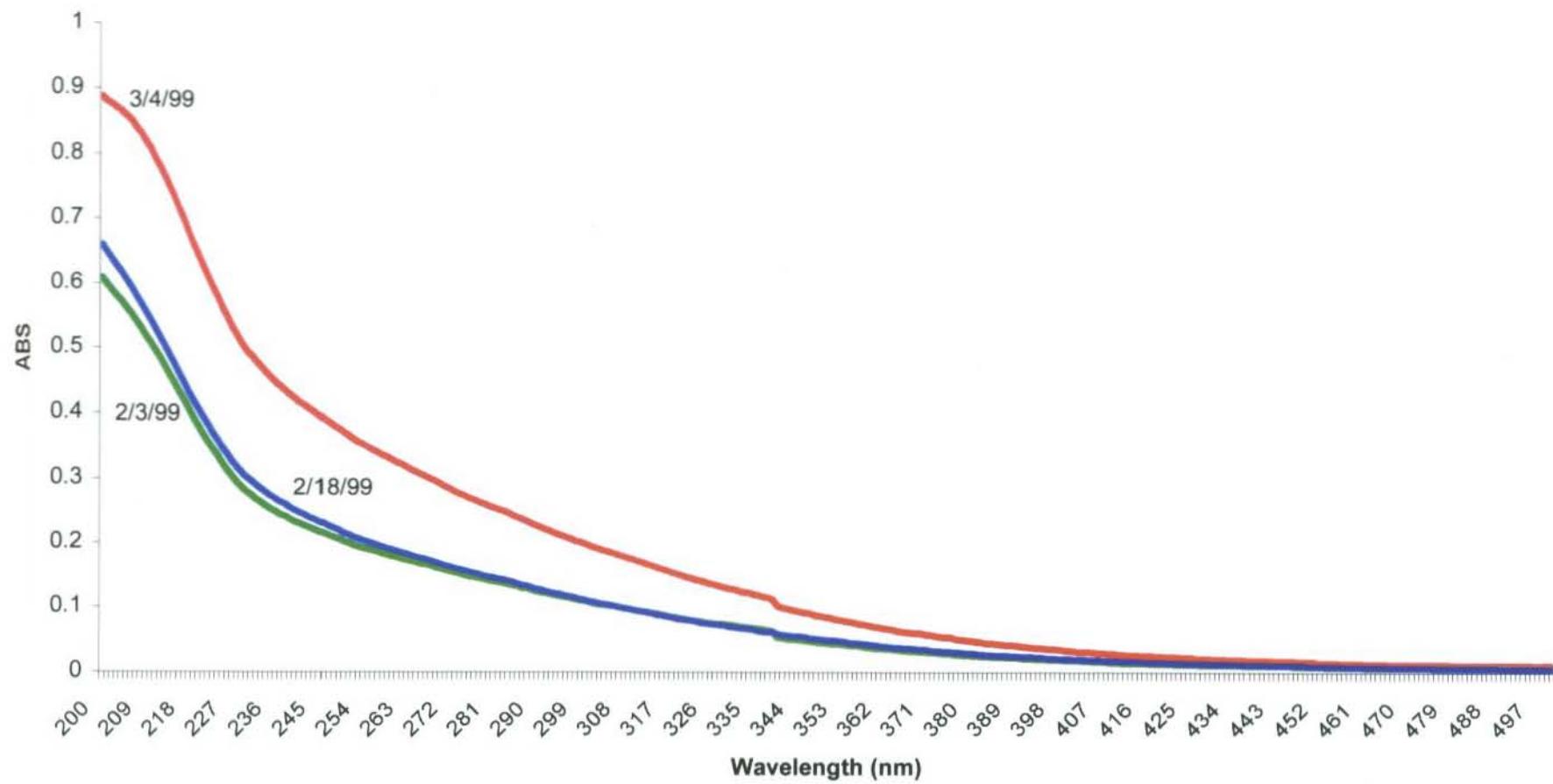
Tank 1
Surface to Sediment Comparison
3/4/99



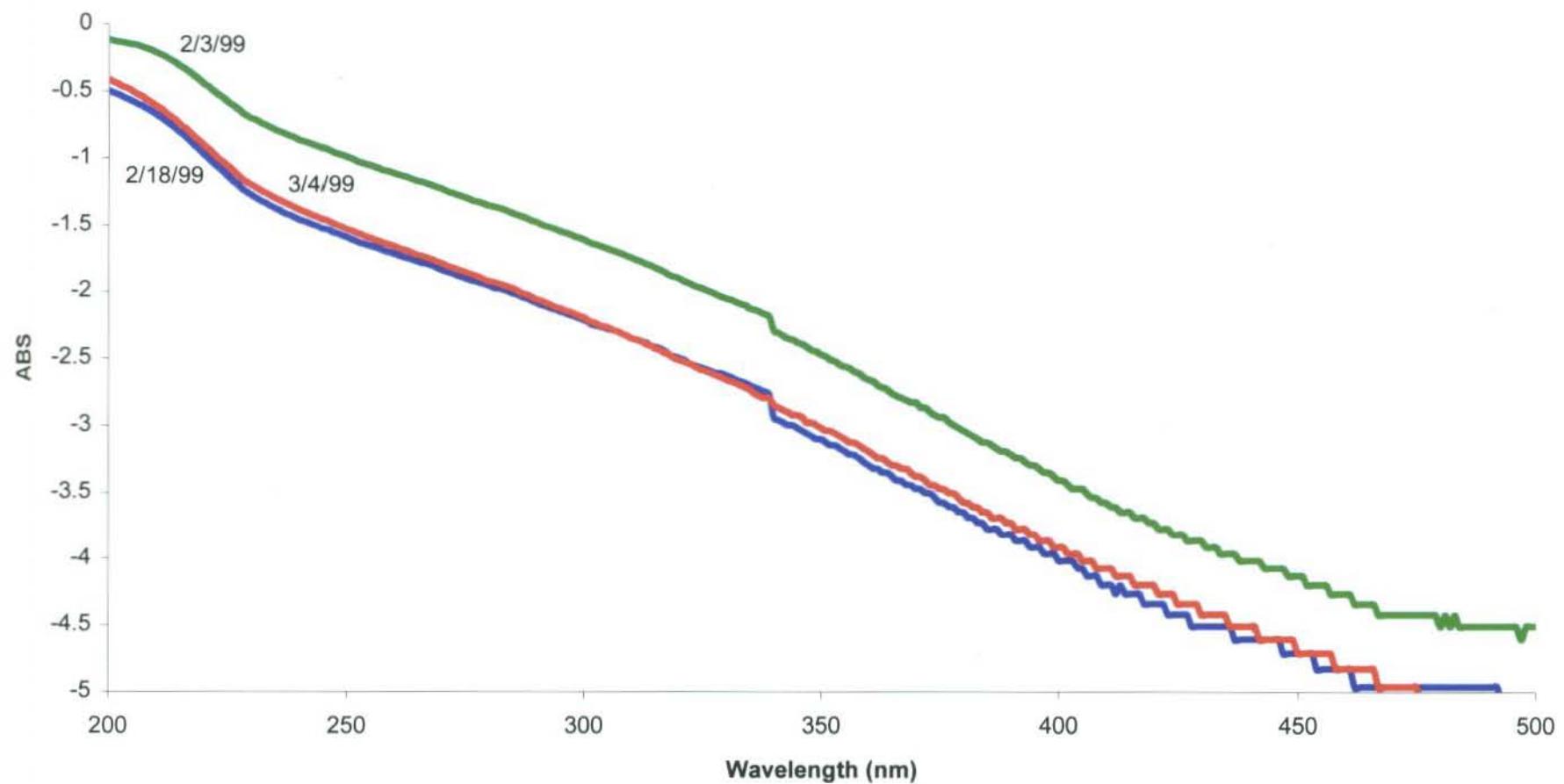
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3/4/99



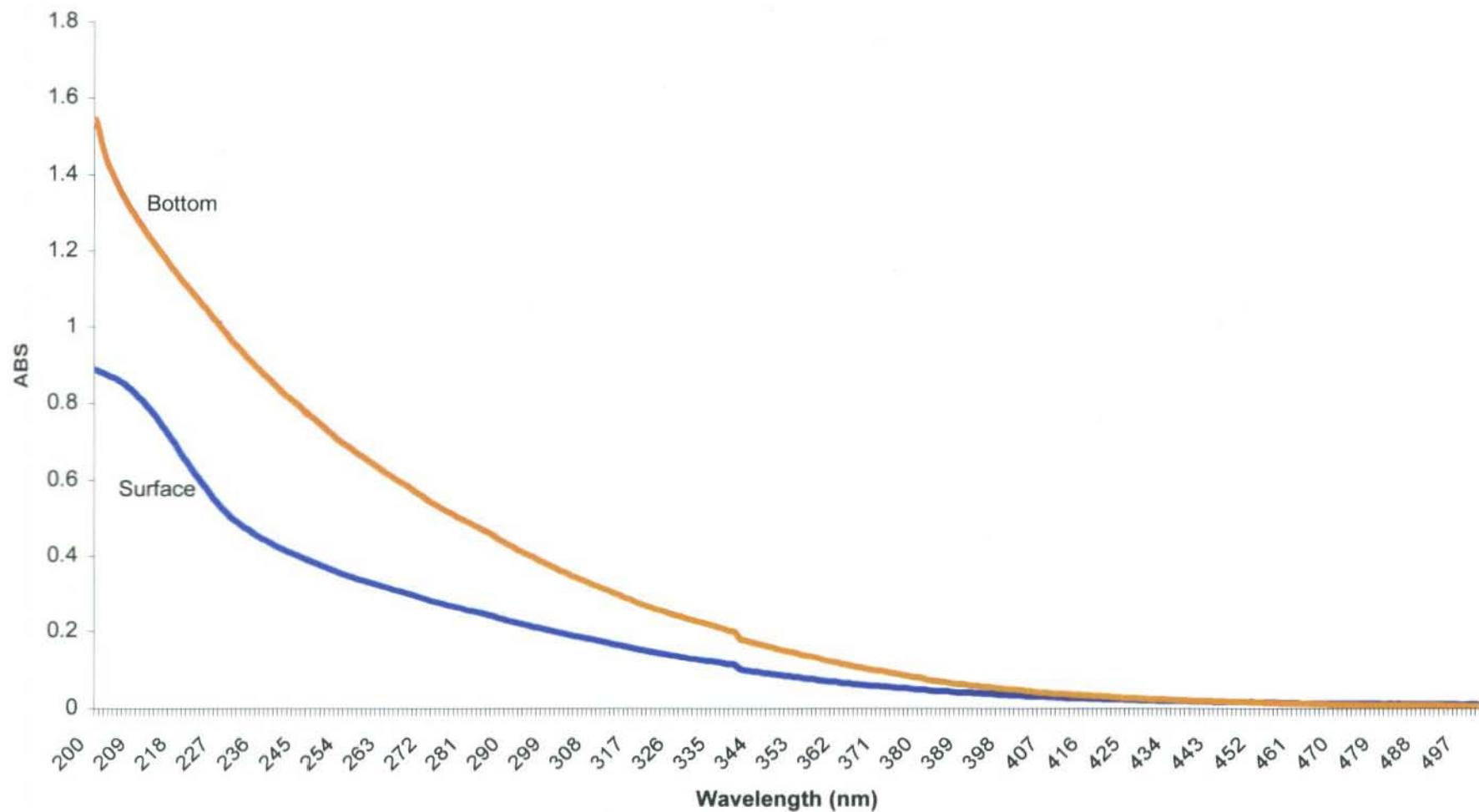
SMARTS Tank 2
Surface Water Comparison
Peat Depth: 1.5 ft
Water Depth: 2 ft
Flow: high @ 1 exch/wk



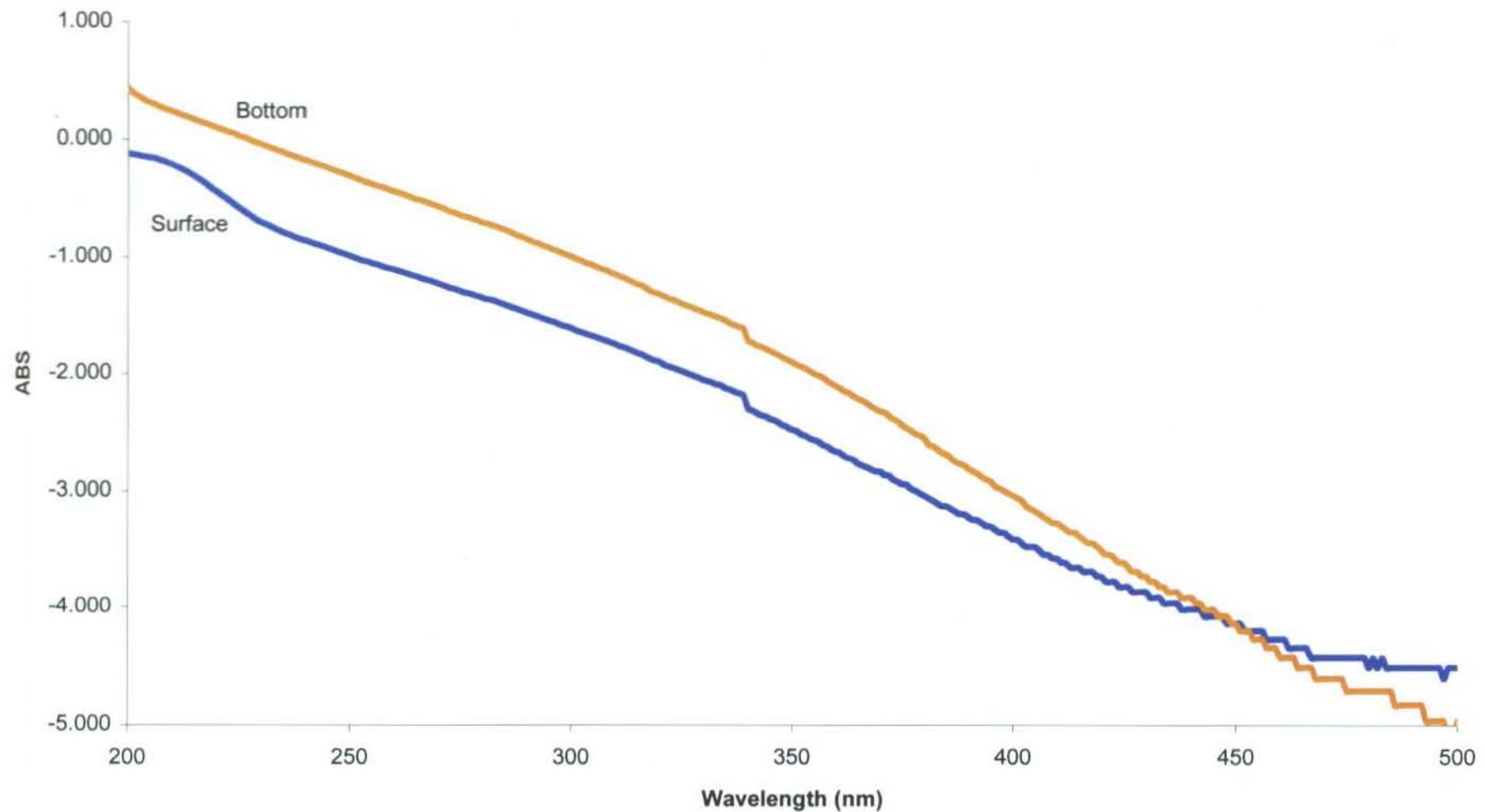
Log of Tank 2
Surface Water Comparison
Peat Depth: 1.5 ft
Water Depth: 2 ft
Flow: high @ 1 exch/wk



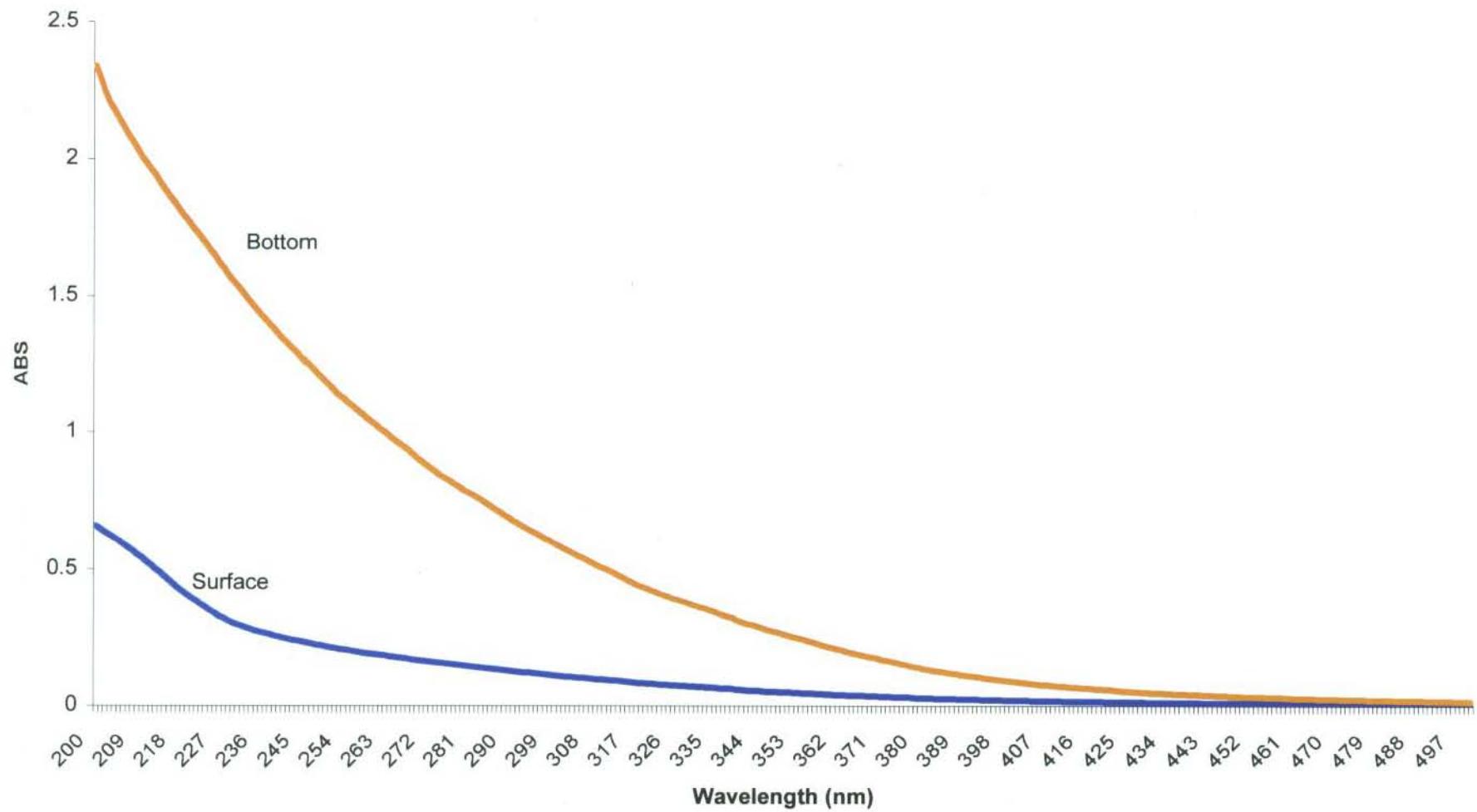
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Surface to Sediment Sample Comparison
2/3/99



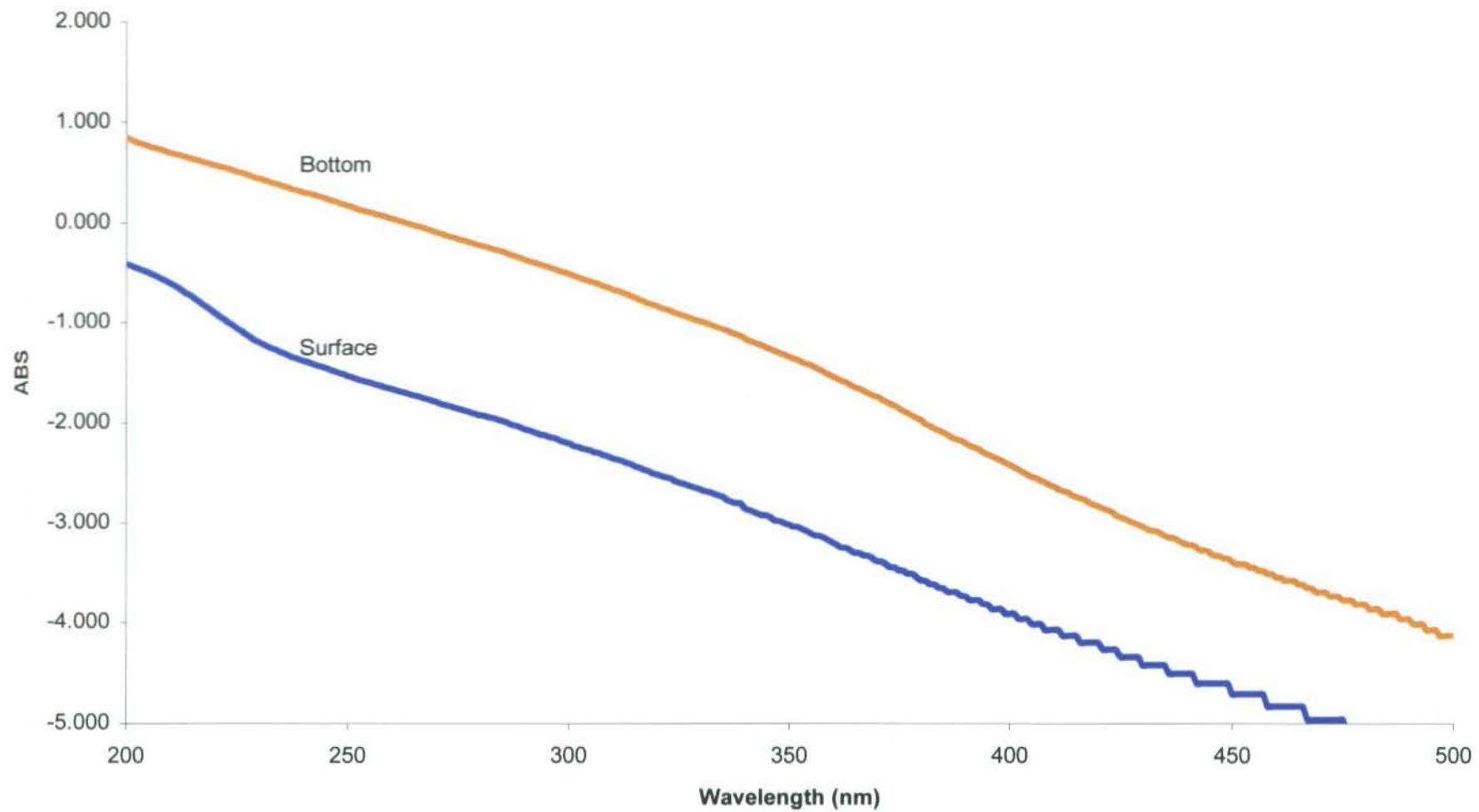
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Surface to Sediment Sample Comparison
2/3/99



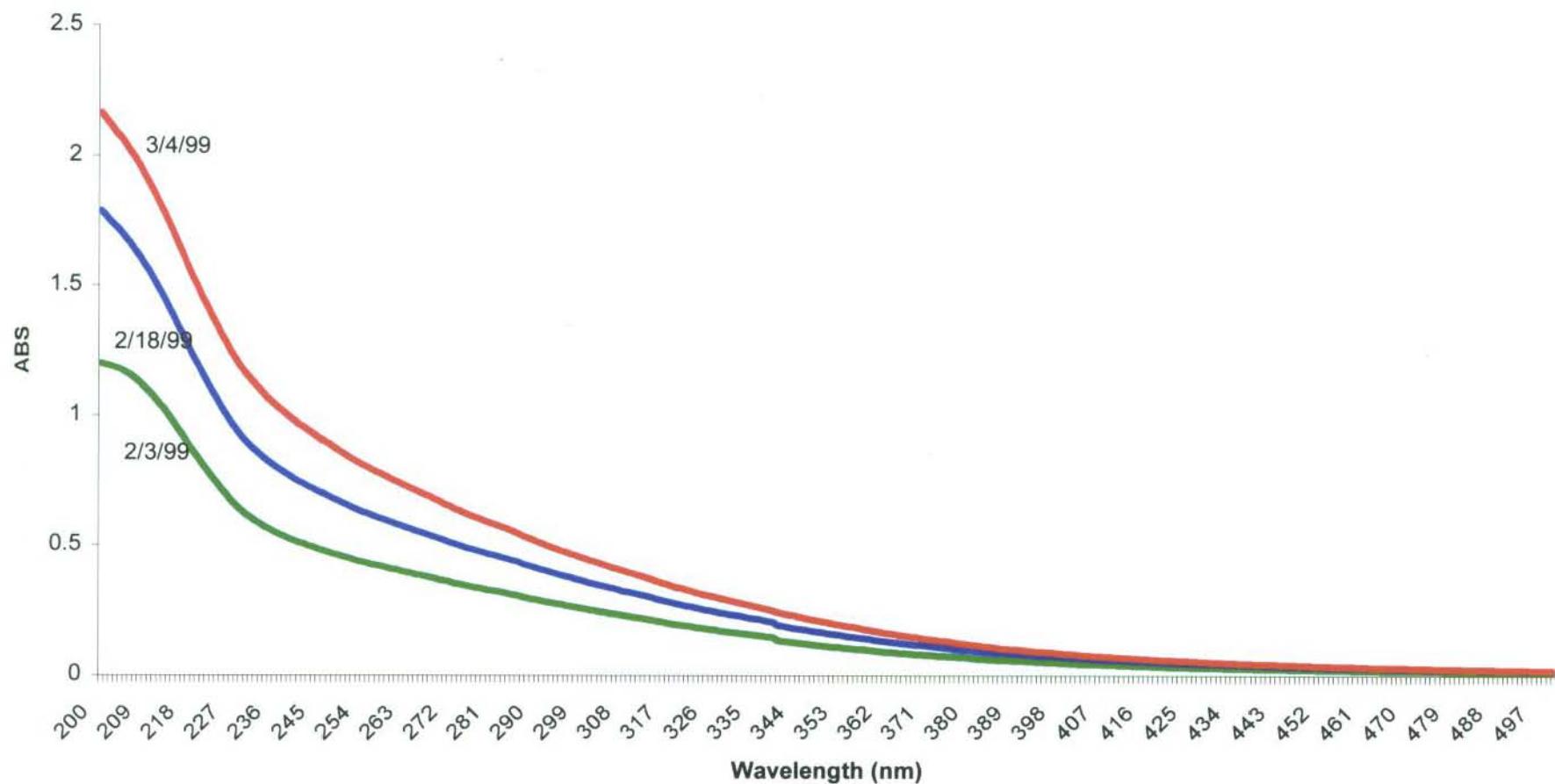
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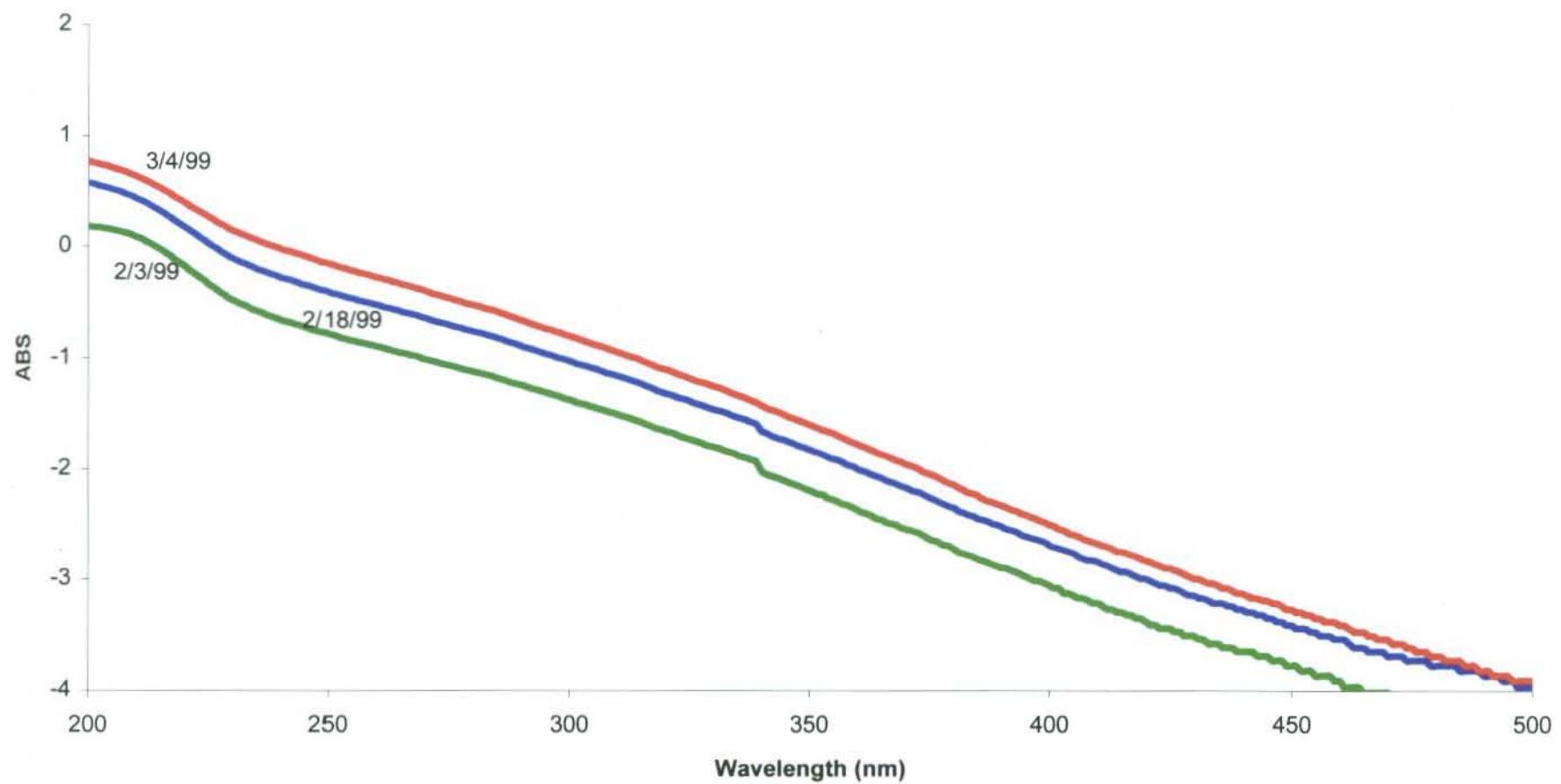
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Surface to Sediment Comparison
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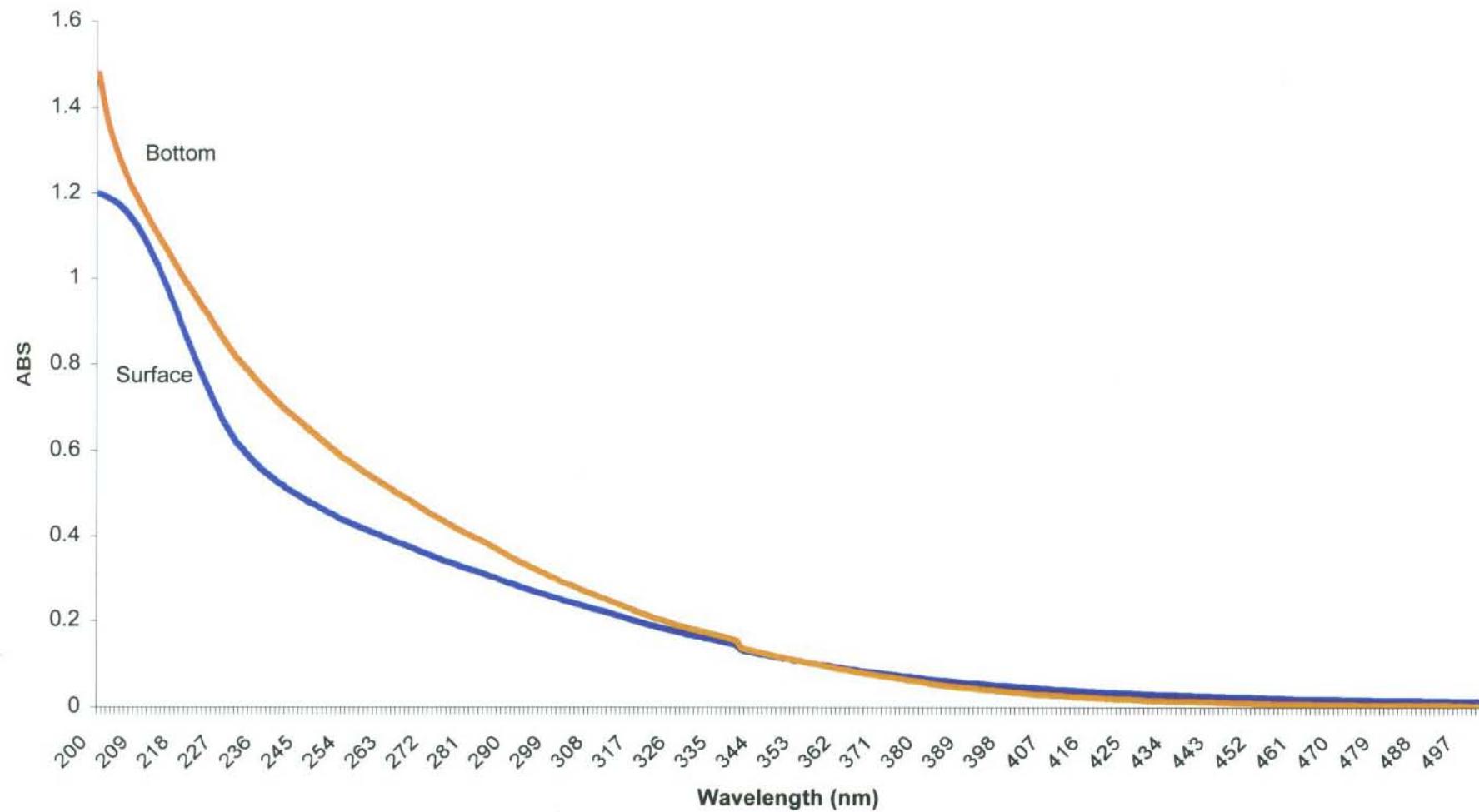
SMARTS Tank 3
Surface Water Comparison
Peat Depth: 4 ft
Water Depth: 2 ft
Flow: low @ stagnant



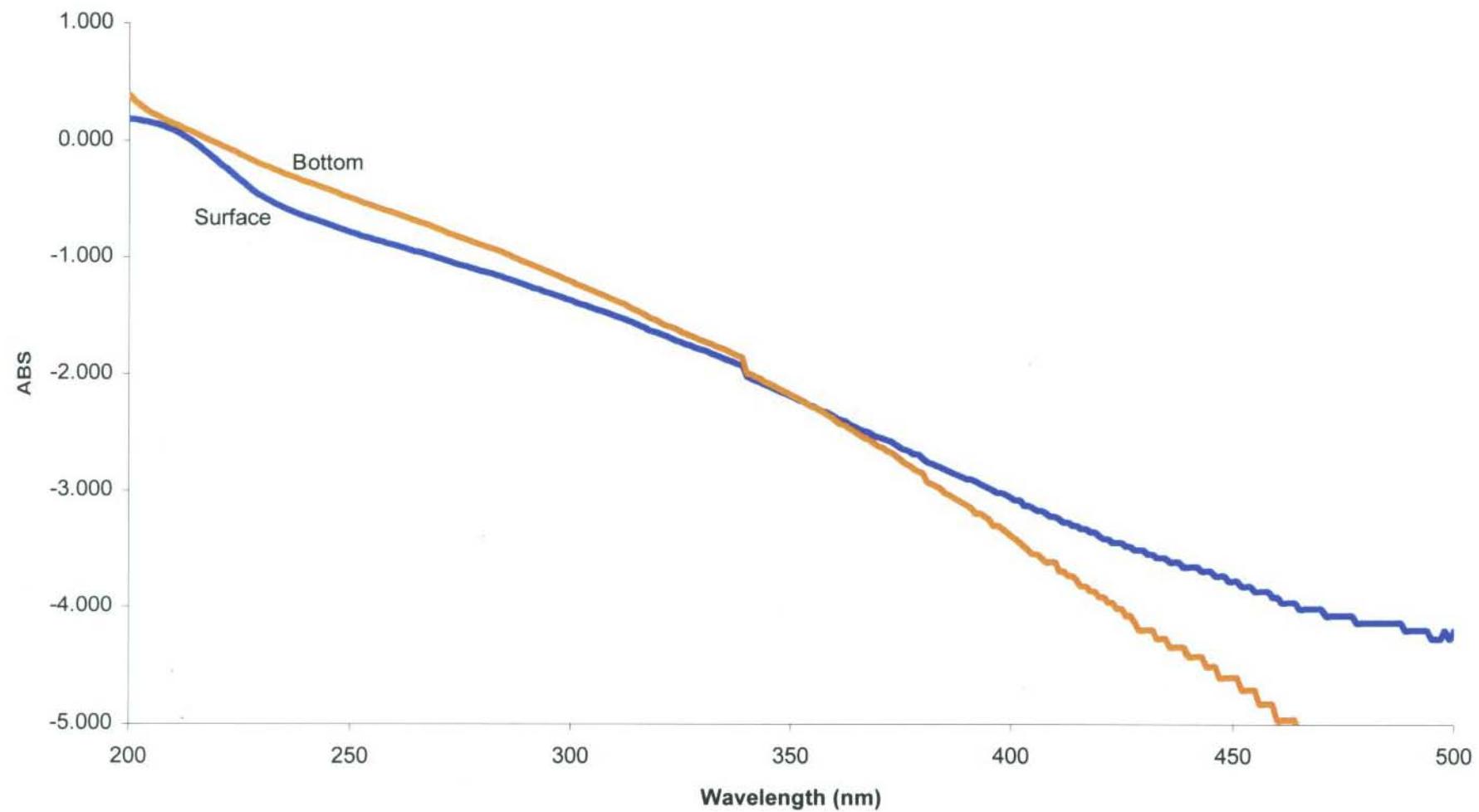
Log of Tank 3
Surface Water Comparison
Peat Depth: 4 ft
Water Depth: 2 ft
Flow: low @ stagnant



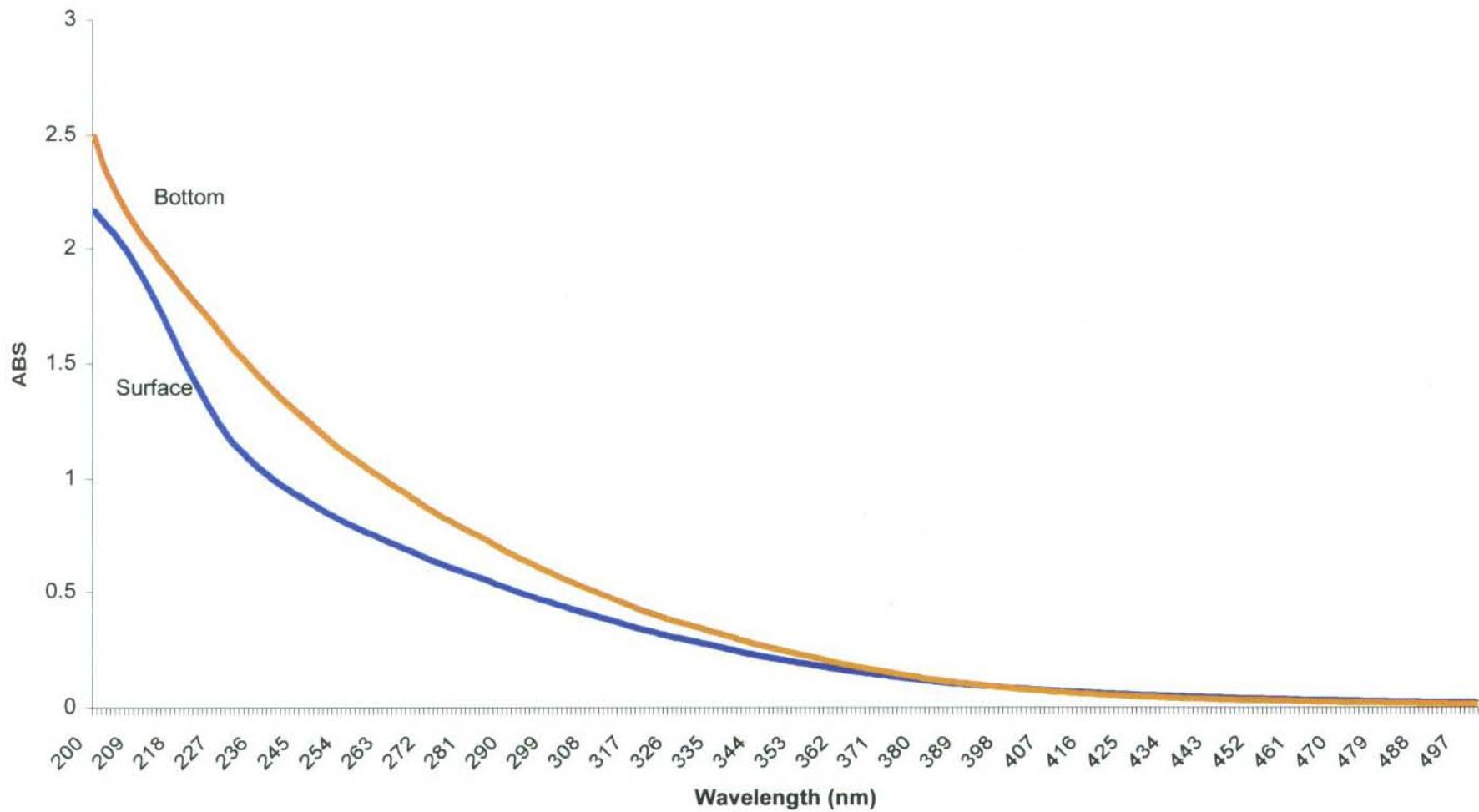
Tank 3
Surface to Sediment Sample Comparison
2/3/99



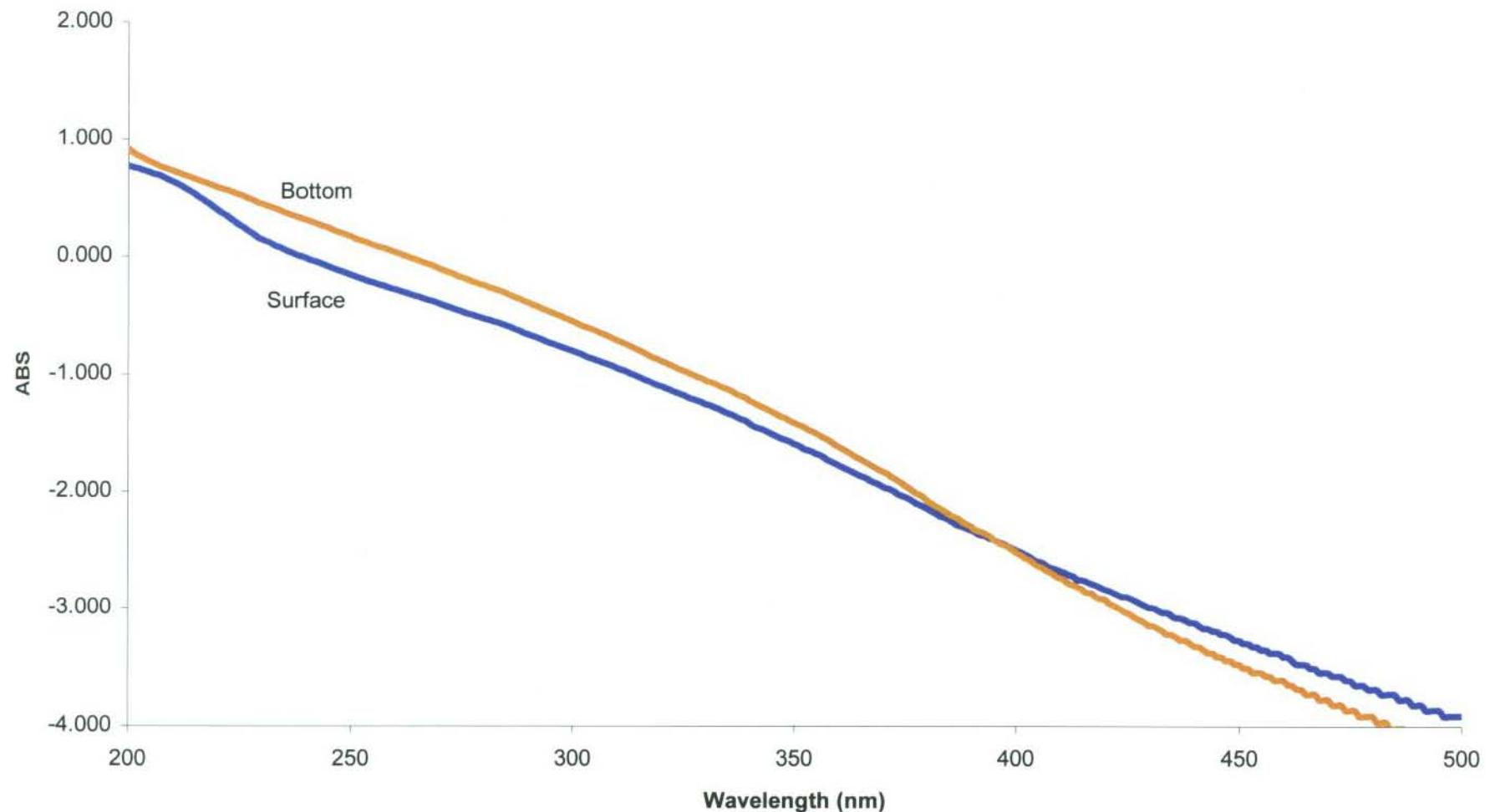
Log of Tank 3
Surface to Sediment Sample Comparison
2/3/99



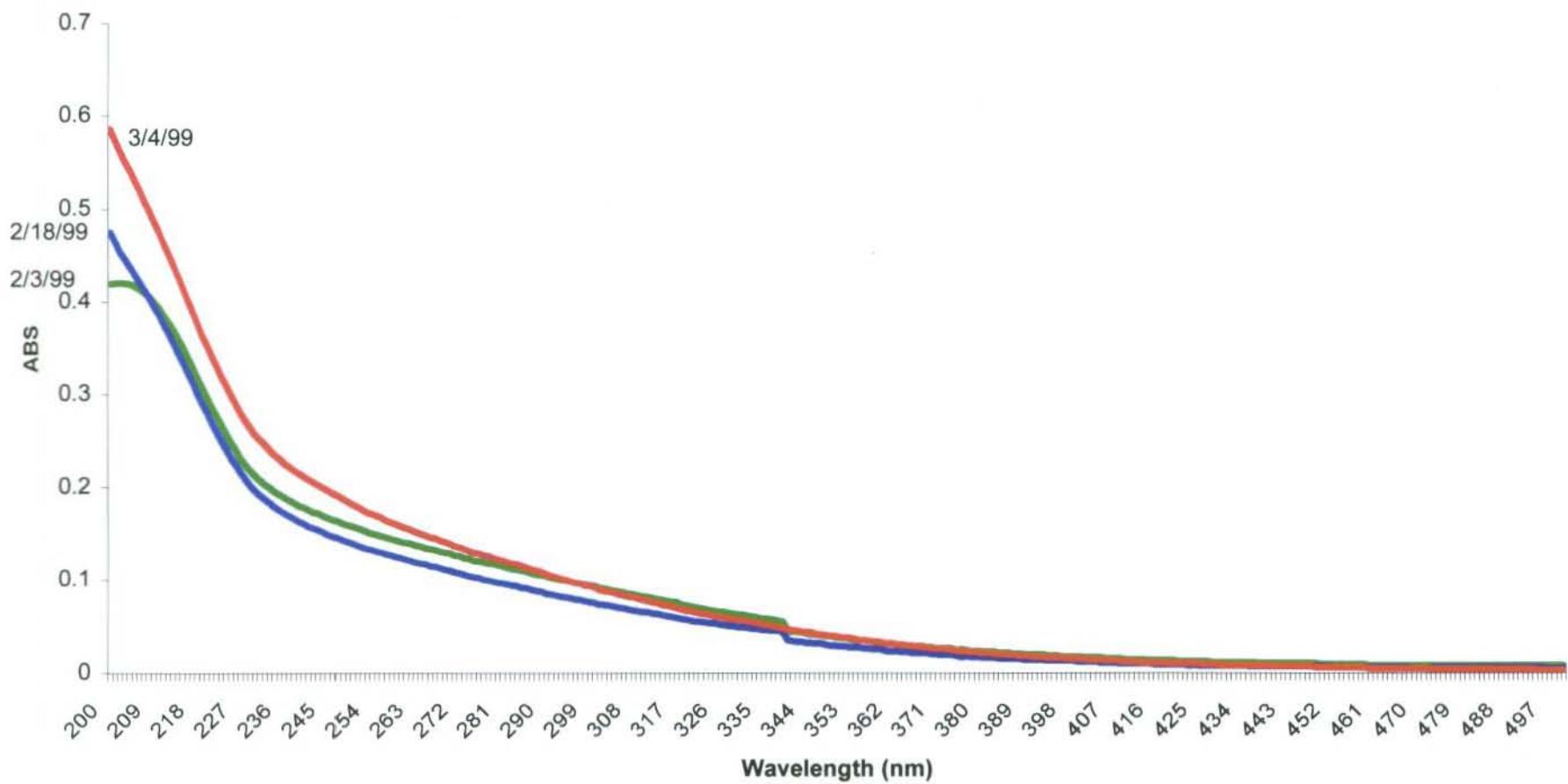
Tank 3
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3/4/99



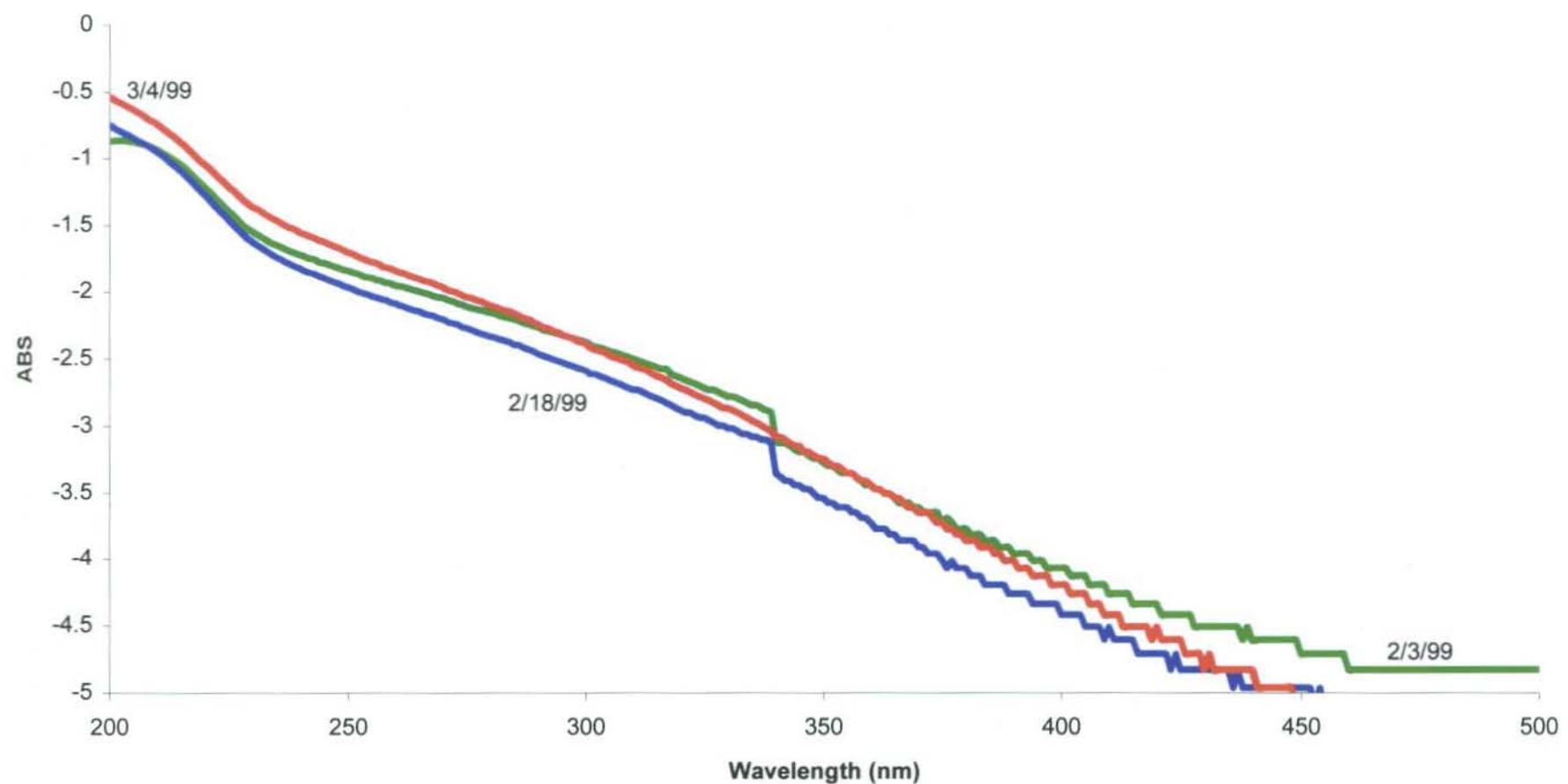
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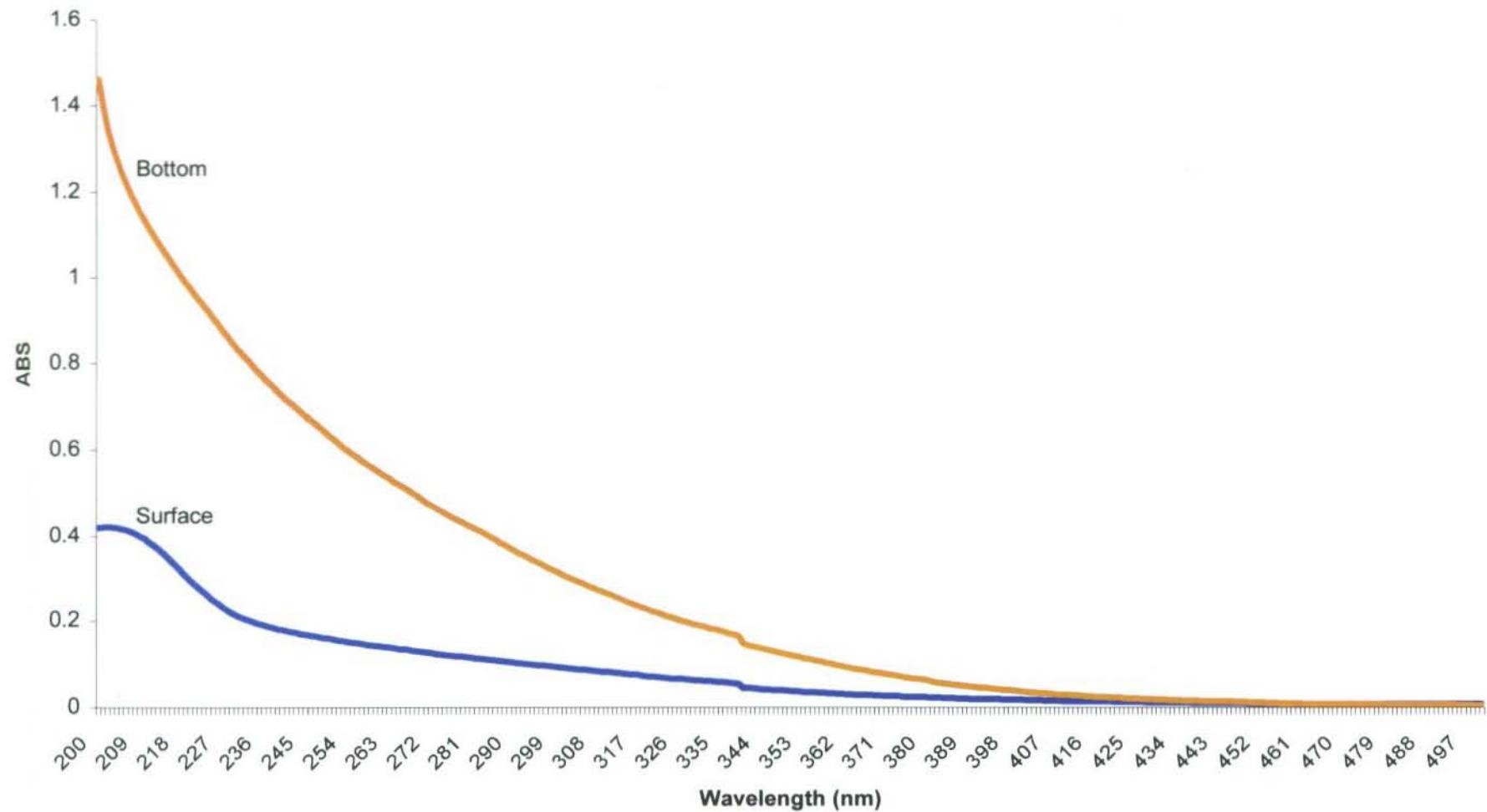
SMARTS Tank 4
Surface Water Comparison
Peat Depth: 4 ft
Water Depth: 2 ft
Flow: high @ 1 exch/wk



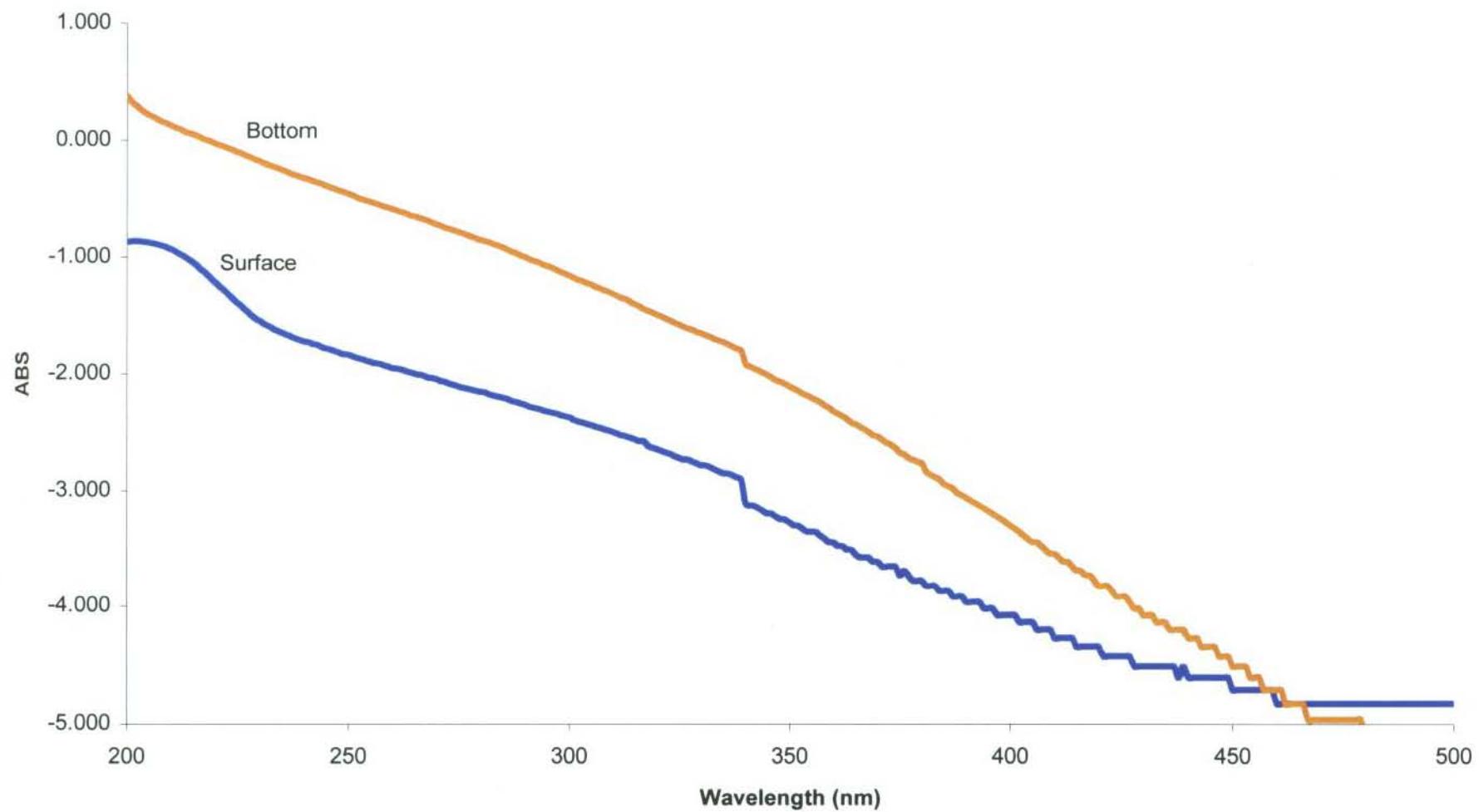
Log of Tank 4
Surface Water Comparison
Peat Depth: 4 ft
Water Depth: 2 ft
Flow: high @ 1 exch/wk



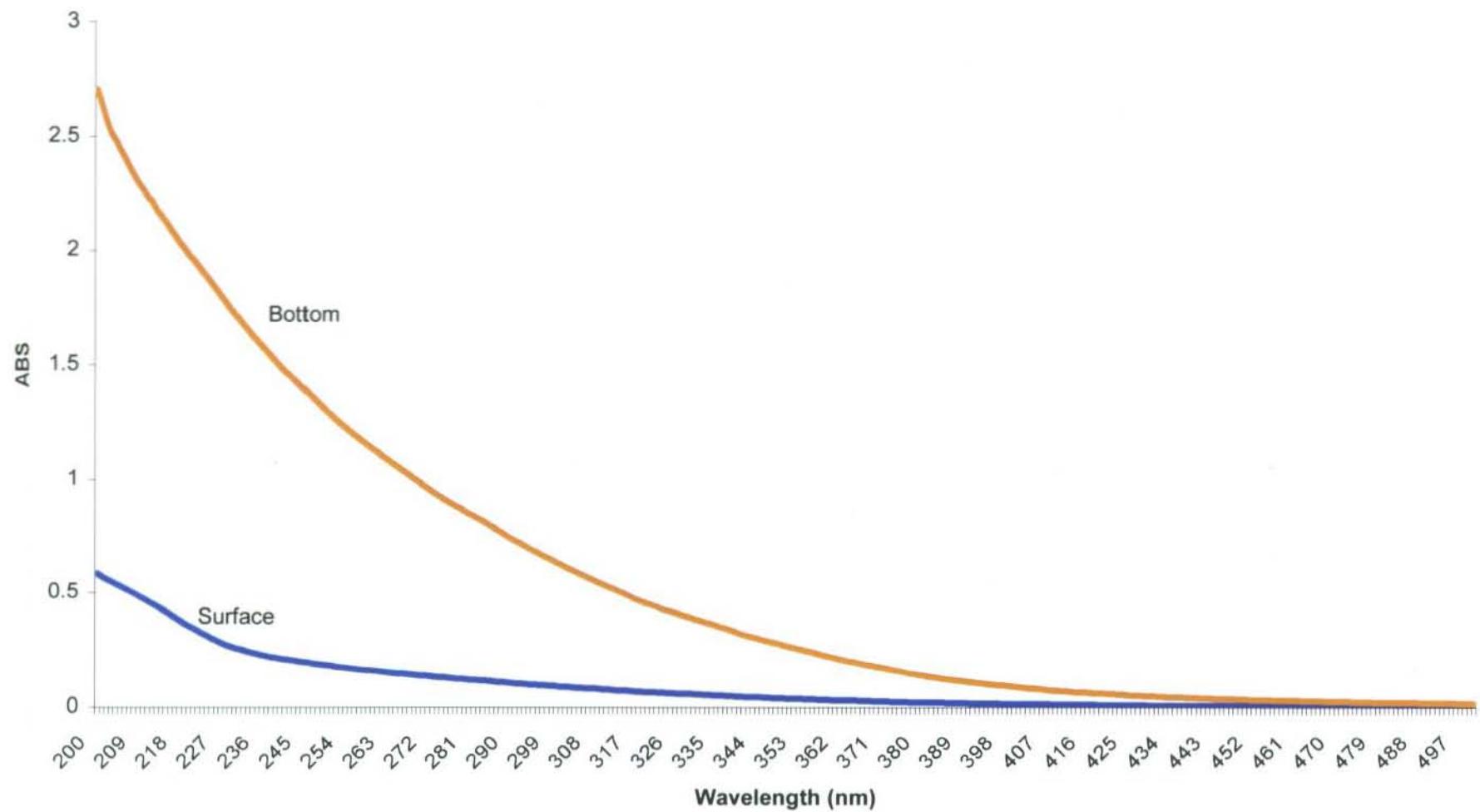
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2/3/99



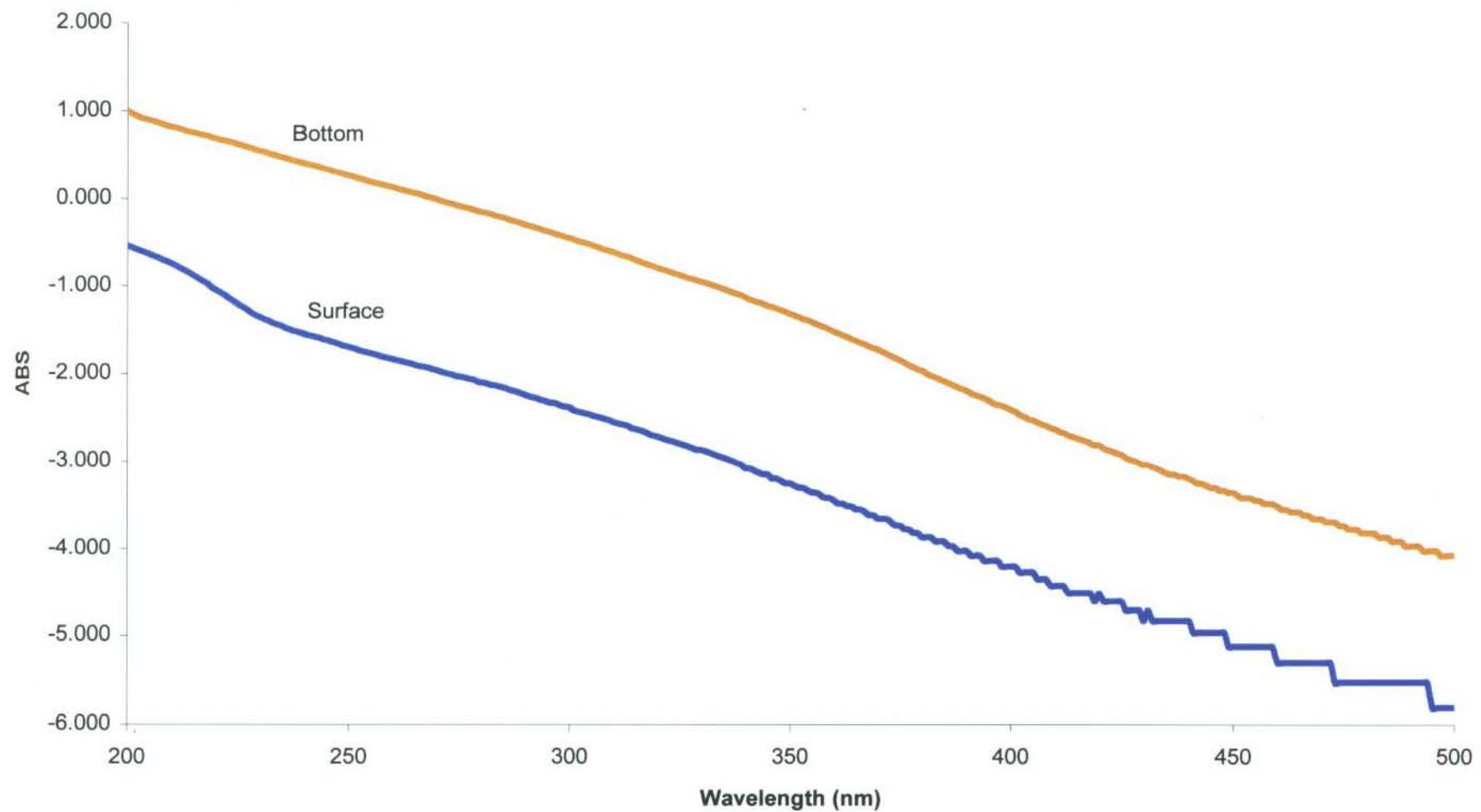
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2/3/99



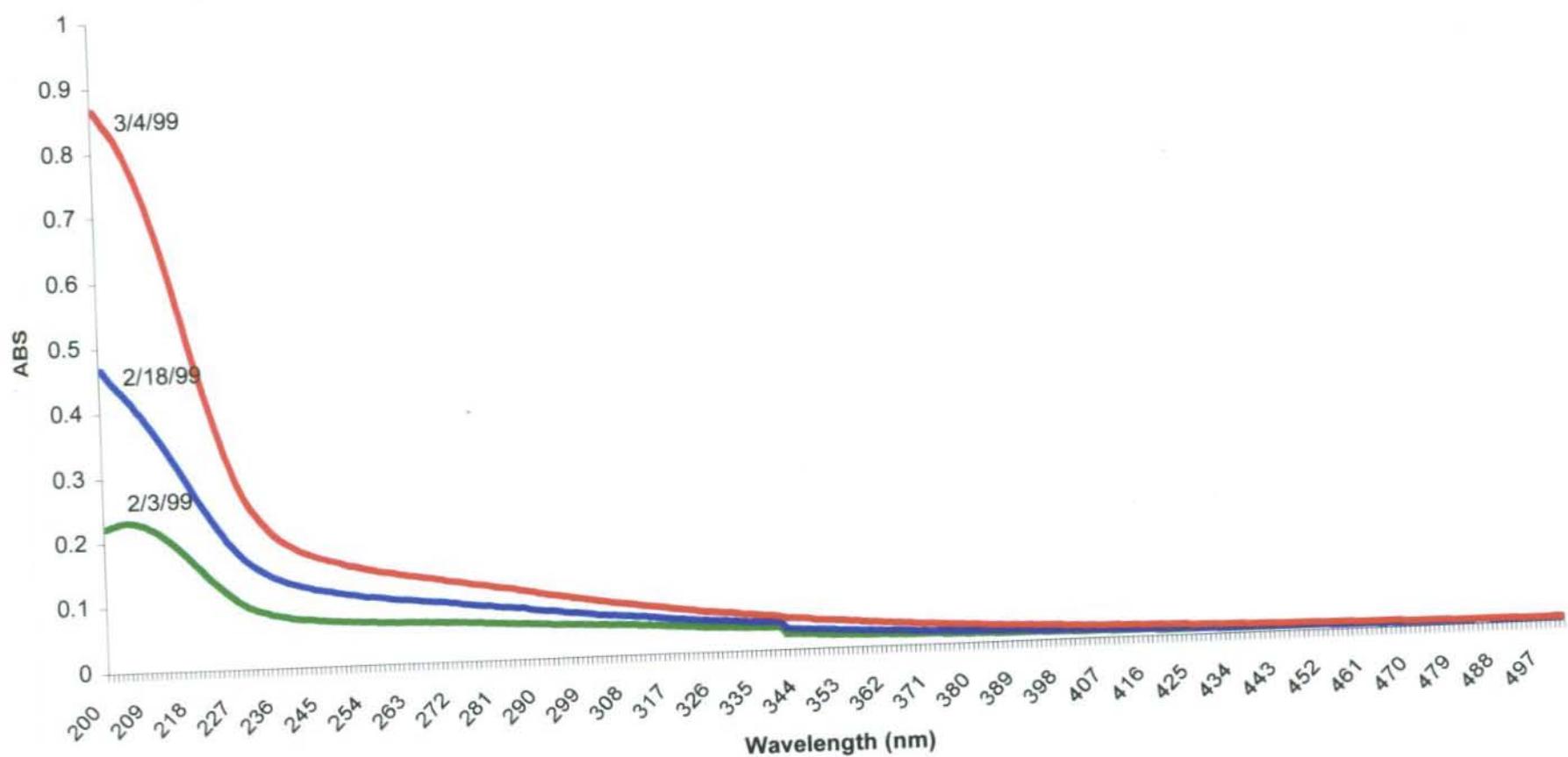
Tank 4
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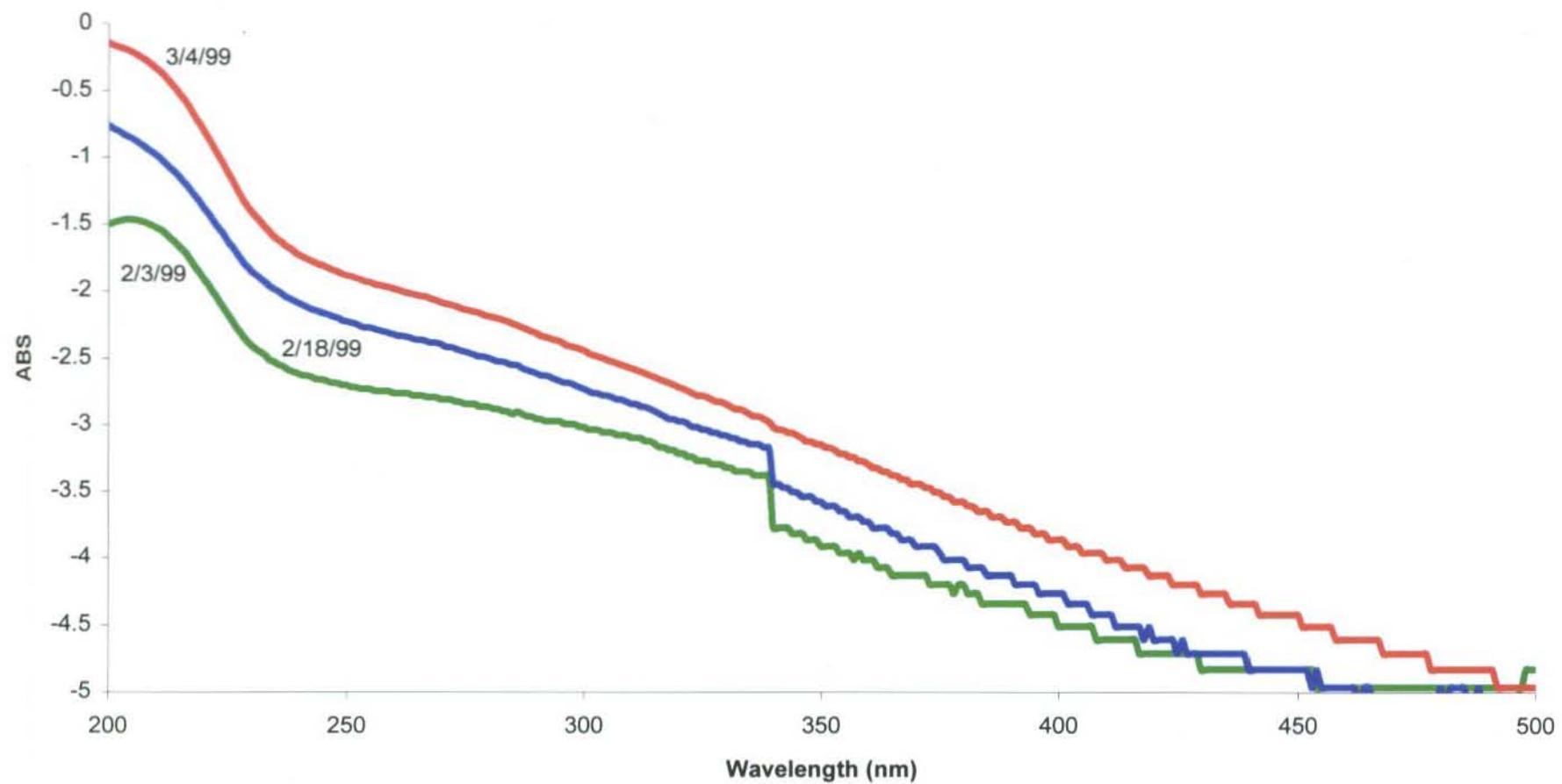
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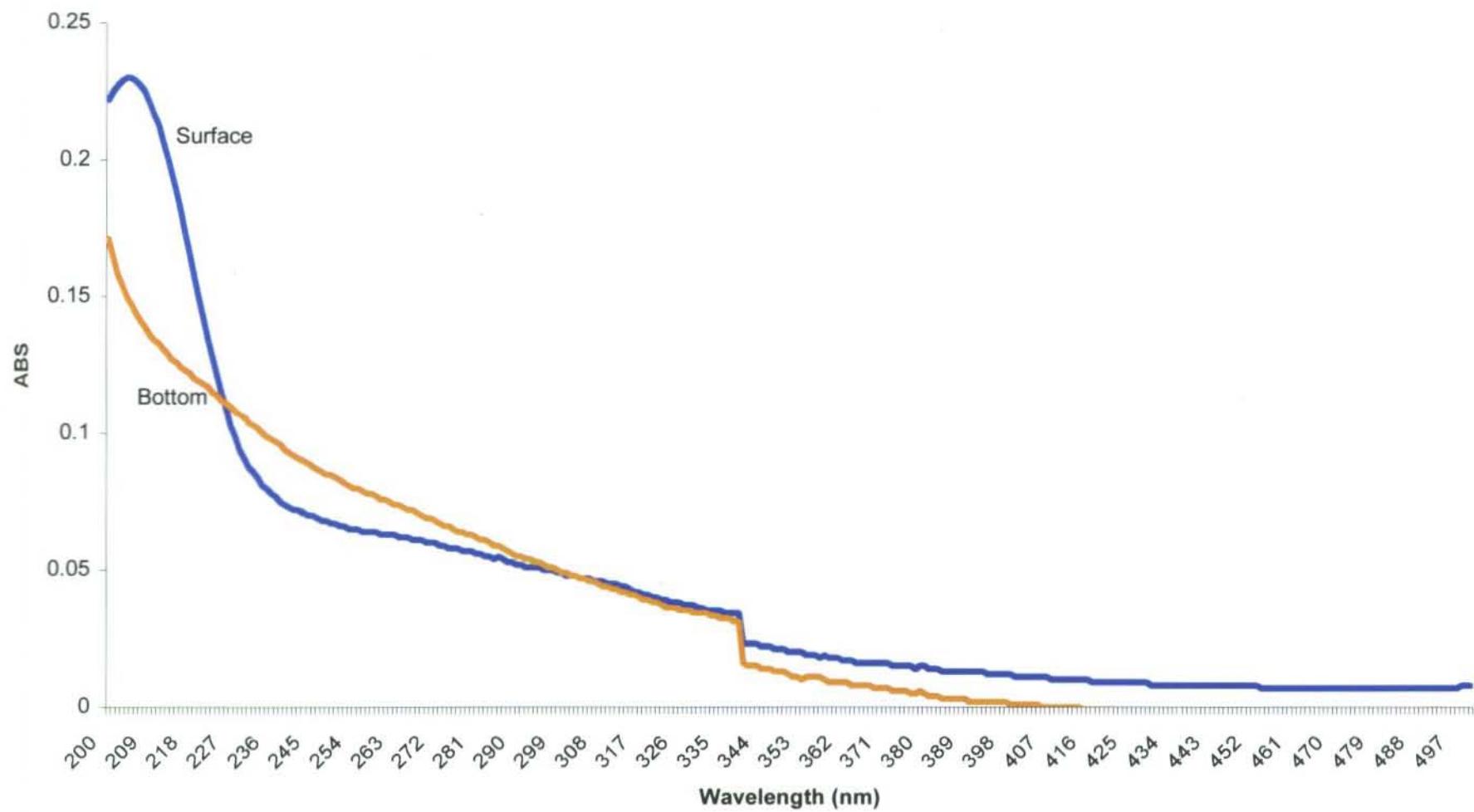
SMARTS Tank 5
Surface Water Comparison
Peat Depth: 4 ft
Water Depth: 7 ft
Flow: low @ stagnant



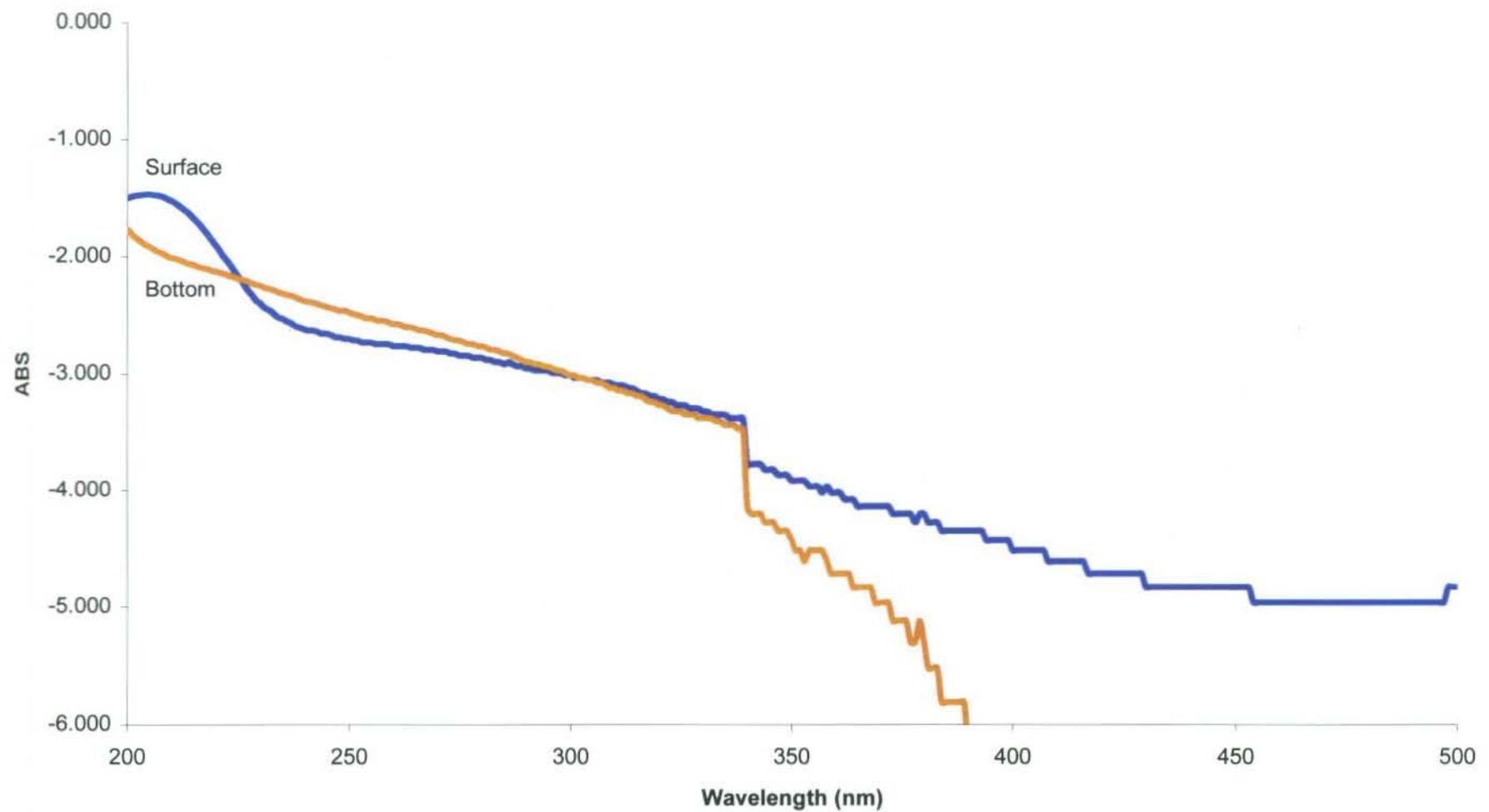
Log of Tank 5
Surface Water Comparison
Peat Depth: 4 ft
Water Depth: 7 ft
Flow: low @ stagnant



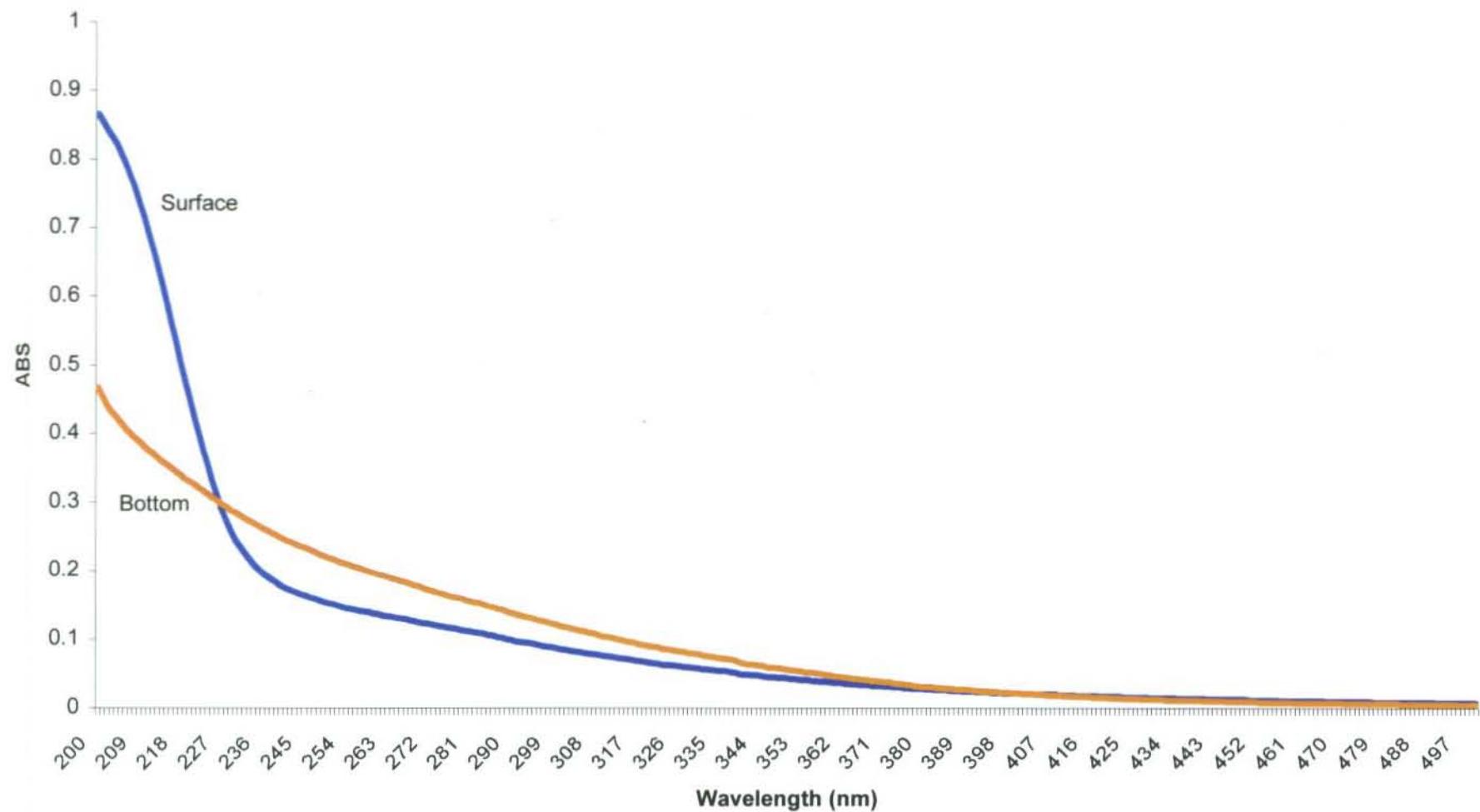
Tank 5
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2/3/99



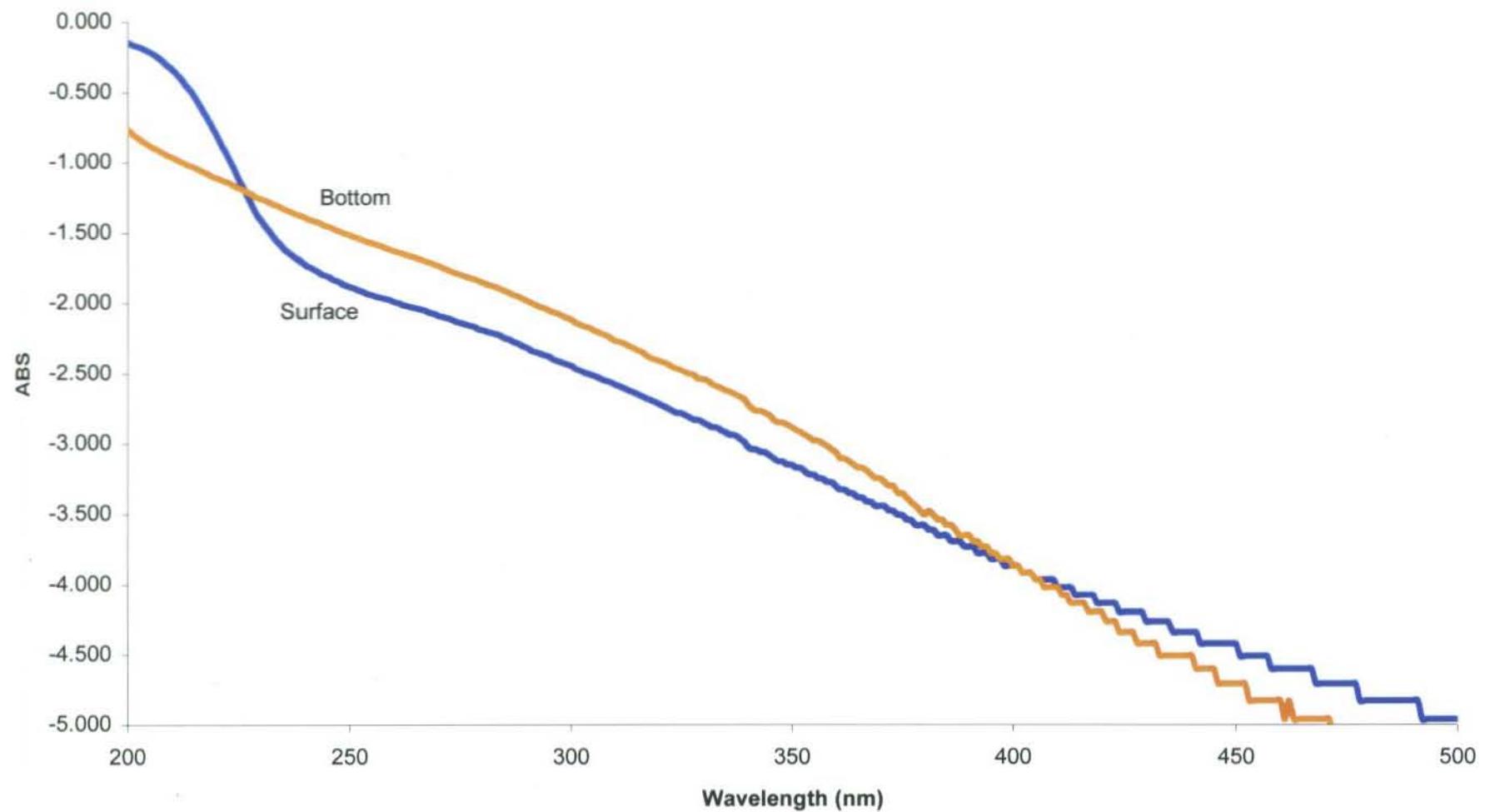
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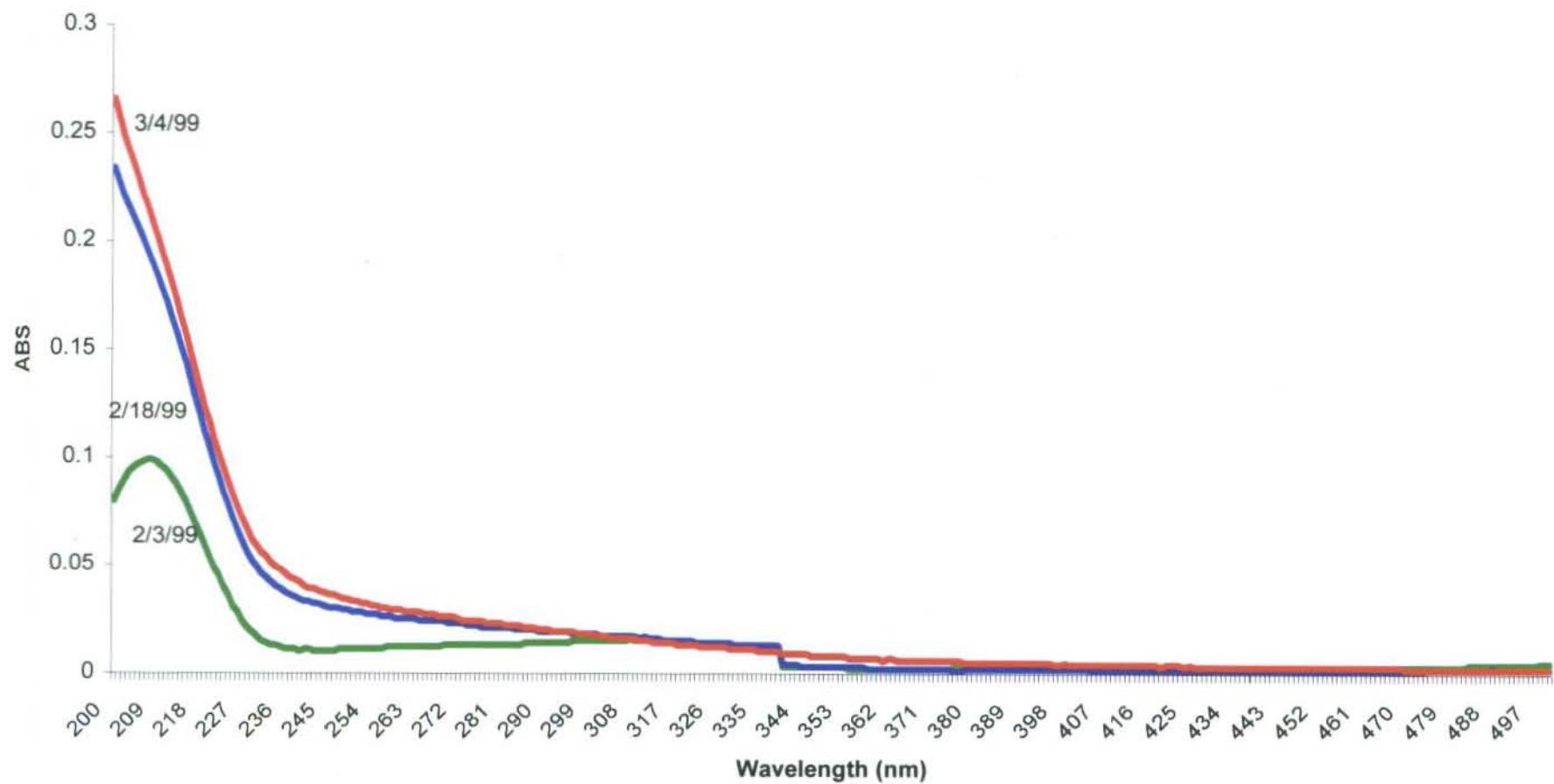
Tank 5
Surface to Sediment Comparison
3/4/99



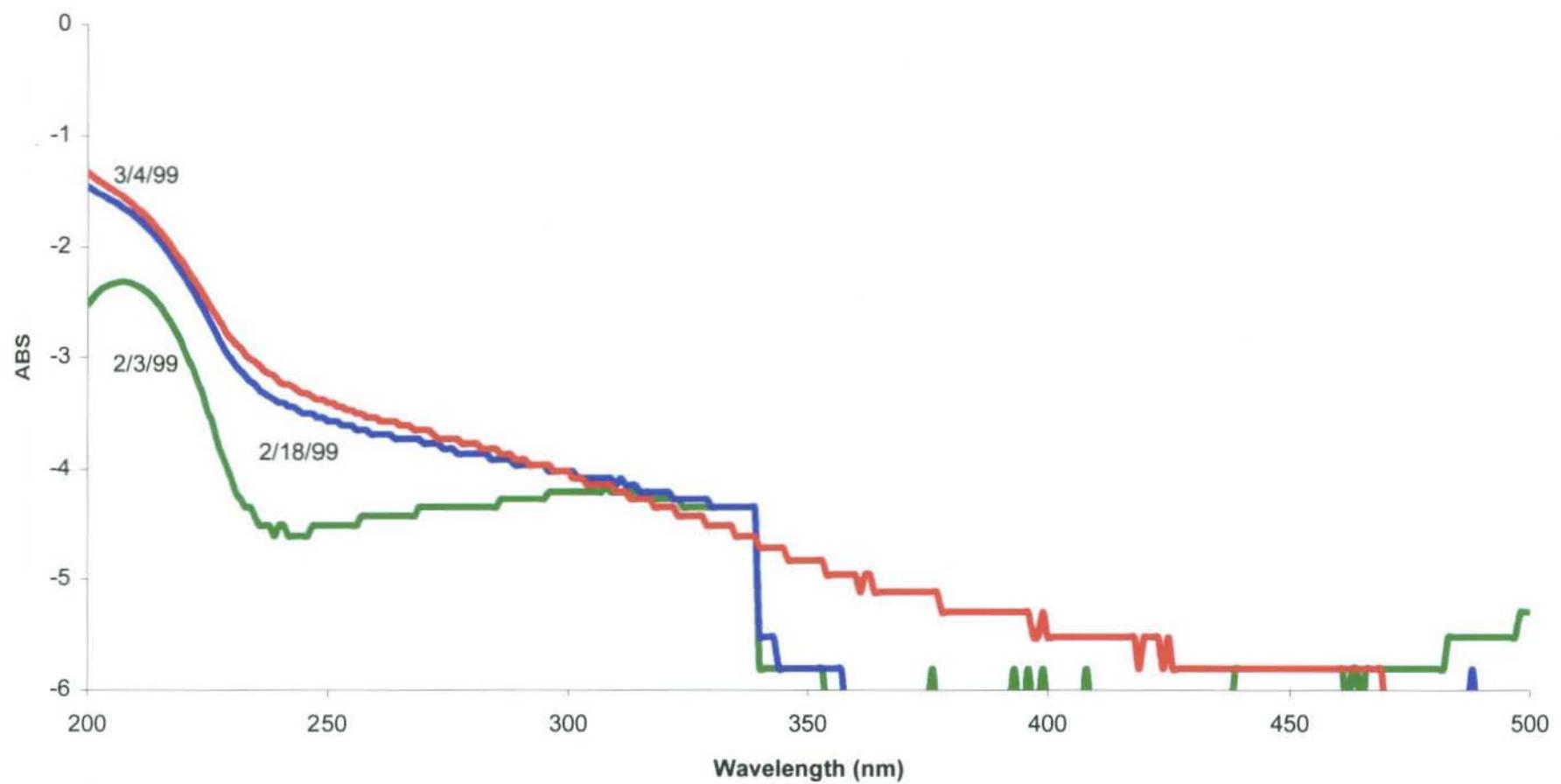
Log of Tank 5
Surface to Sediment Comparison
3/4/99



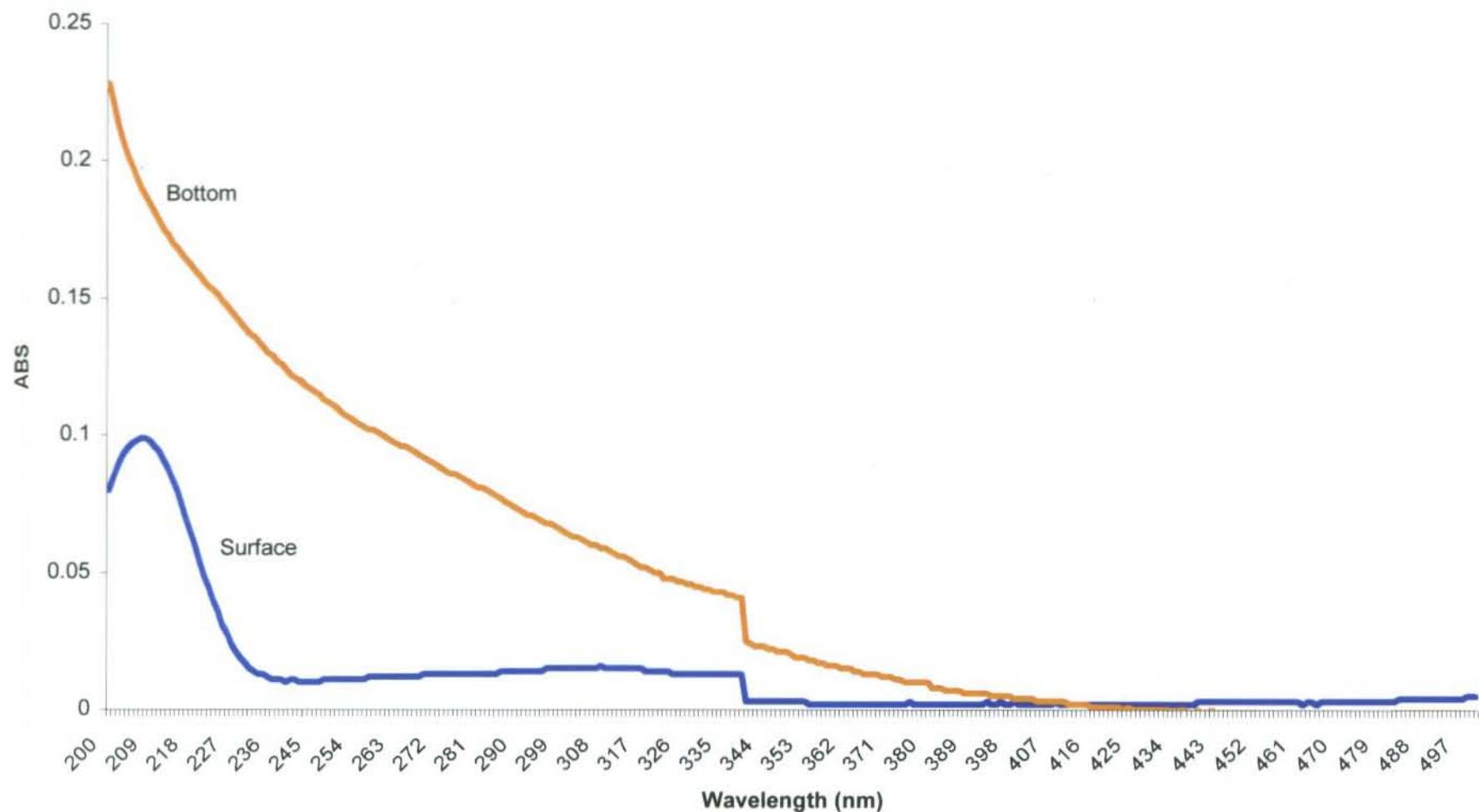
SMARTS Tank 6
Surface Water Comparison
Peat Depth: 1.5 ft
Water Depth: 7 ft
Flow: high @ 1 exch/wk



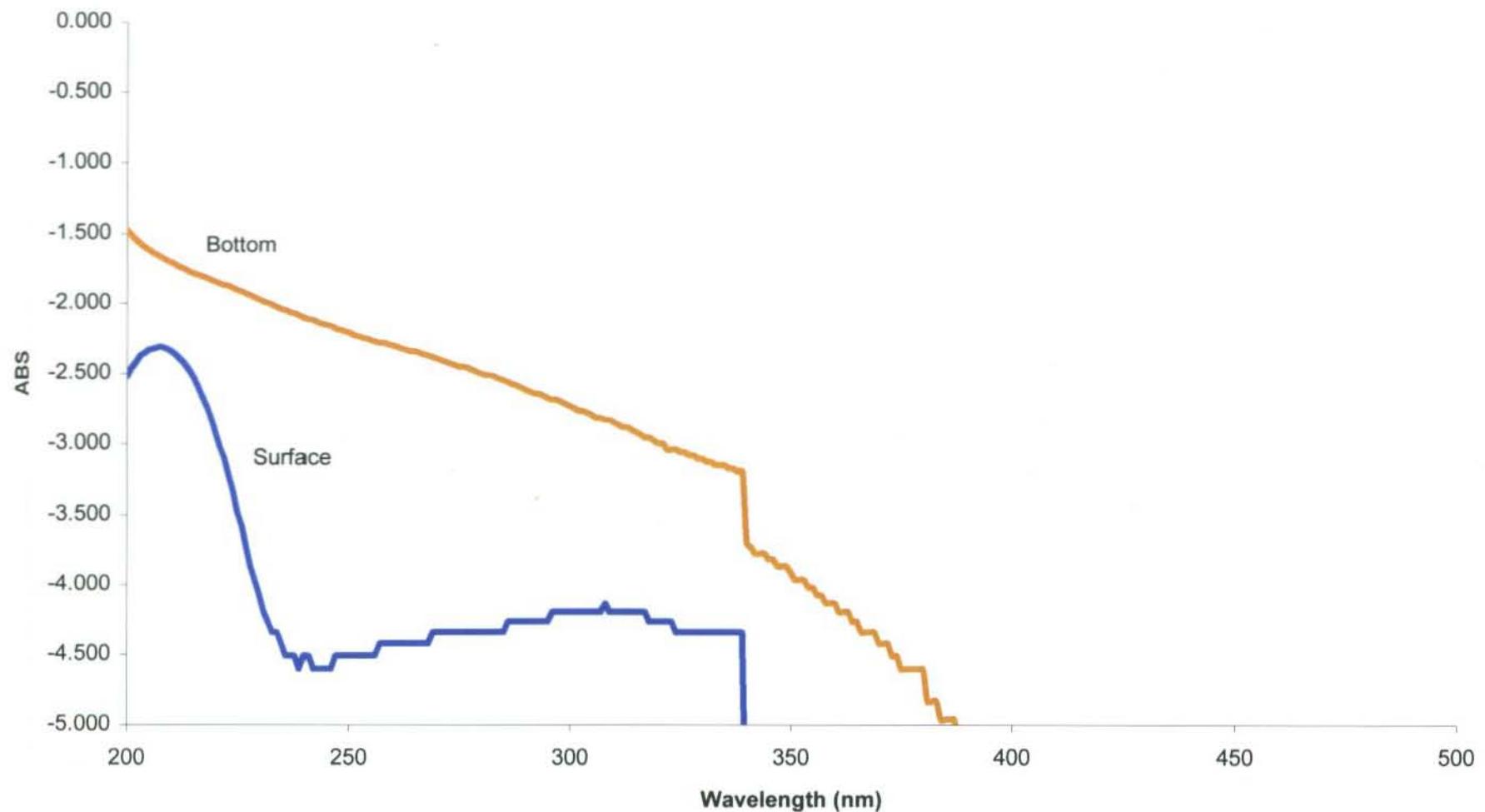
Log of Tank 6
Surface Water Comparison
Peat Depth: 1.5 ft
Water Depth: 7 ft
Flow: high @ 1 exch/wk



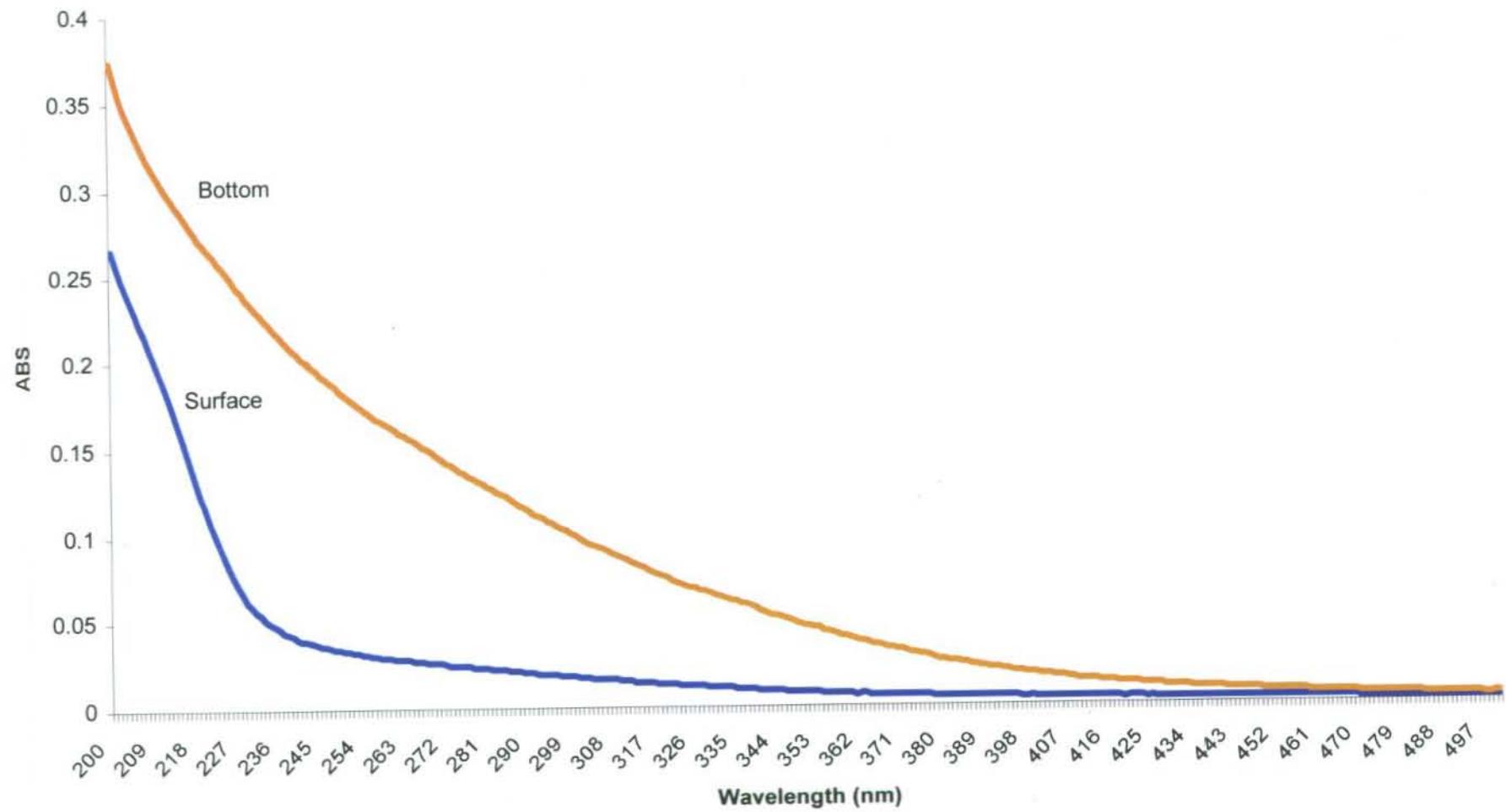
Tank 6
Surface to Sediment Sample Comparison
2/3/99



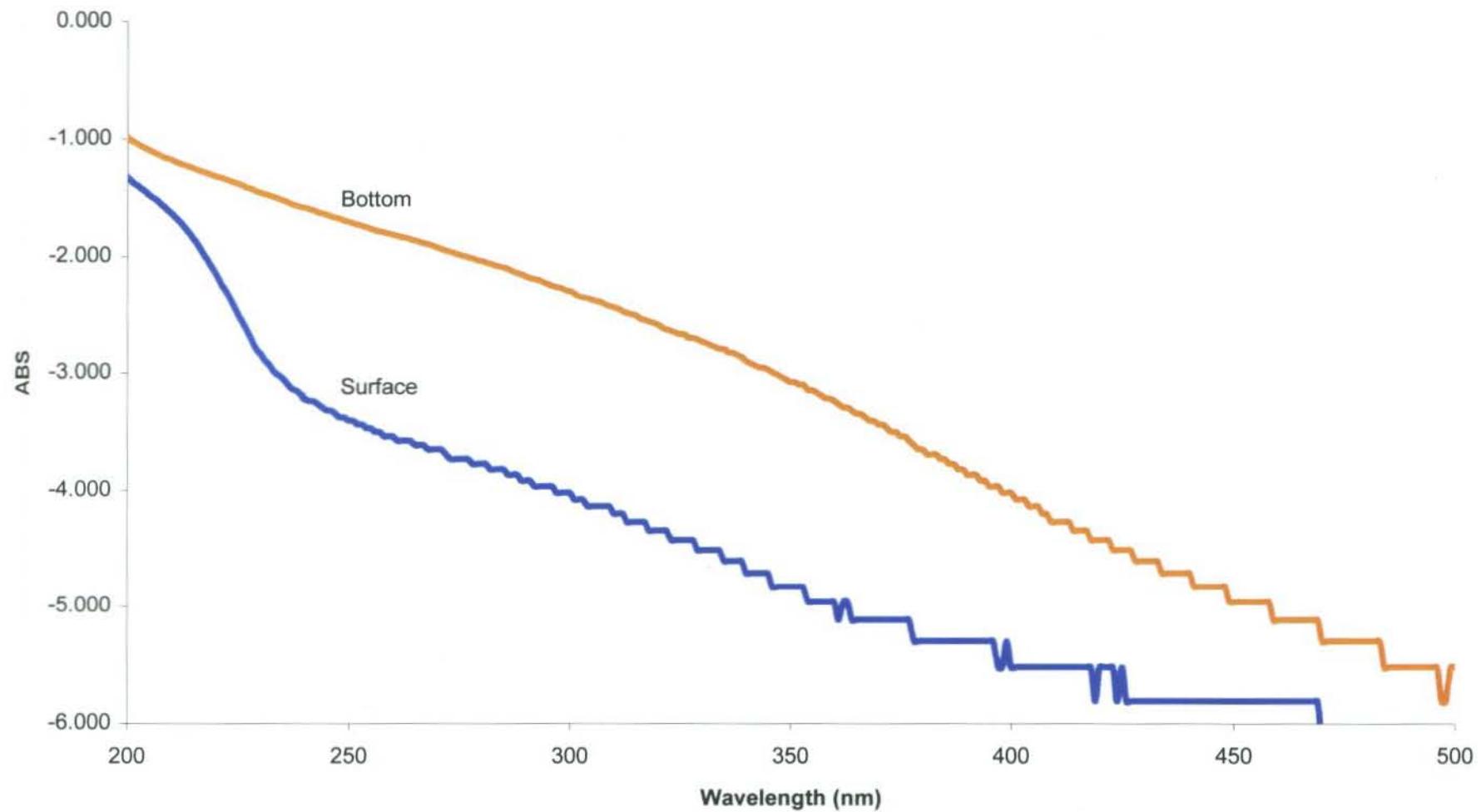
Log of Tank 6
Surface to Sediment Sample Comparison
2/3/99



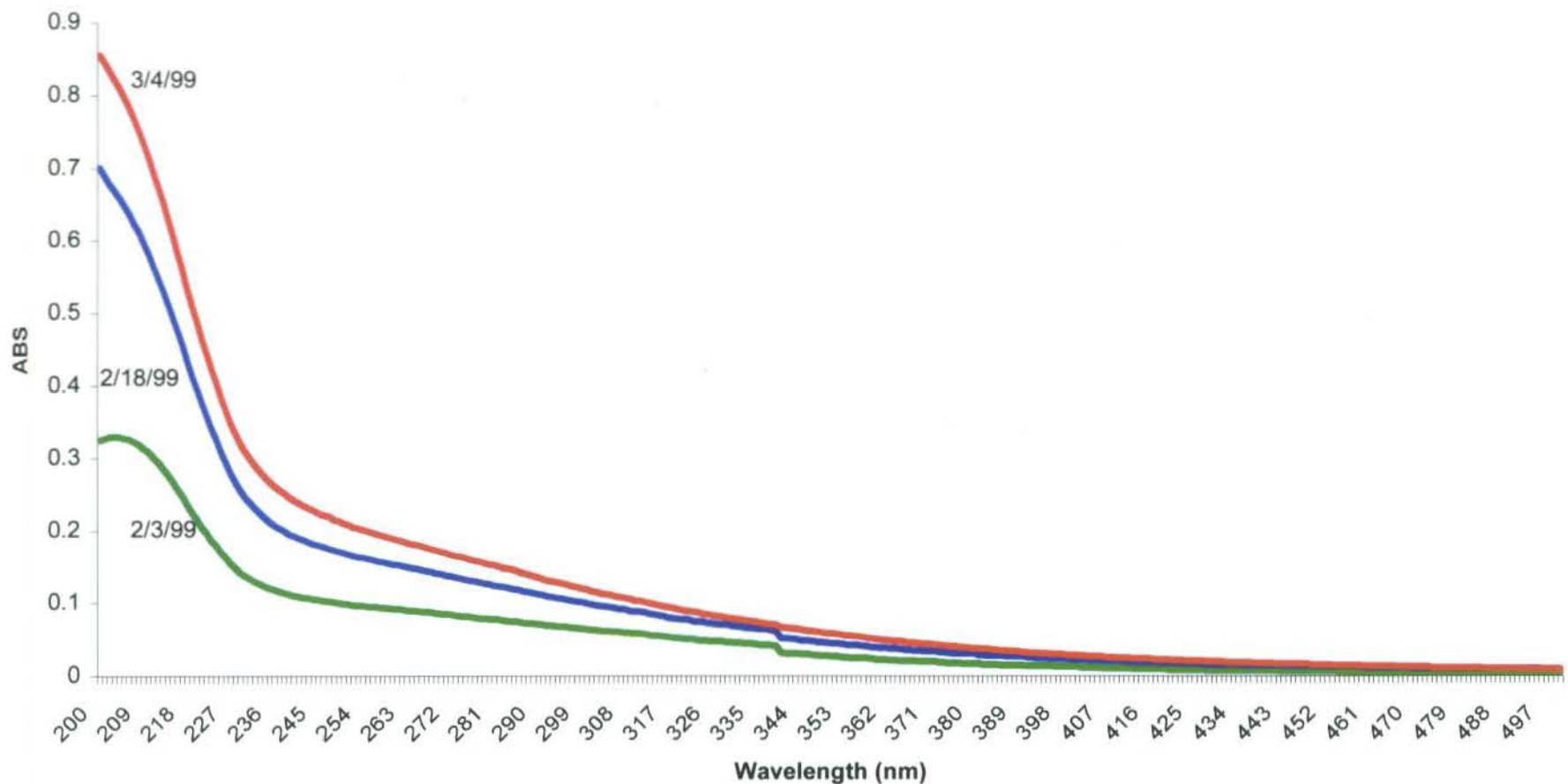
Tank 6
Surface to Sediment Comparison
3/4/99



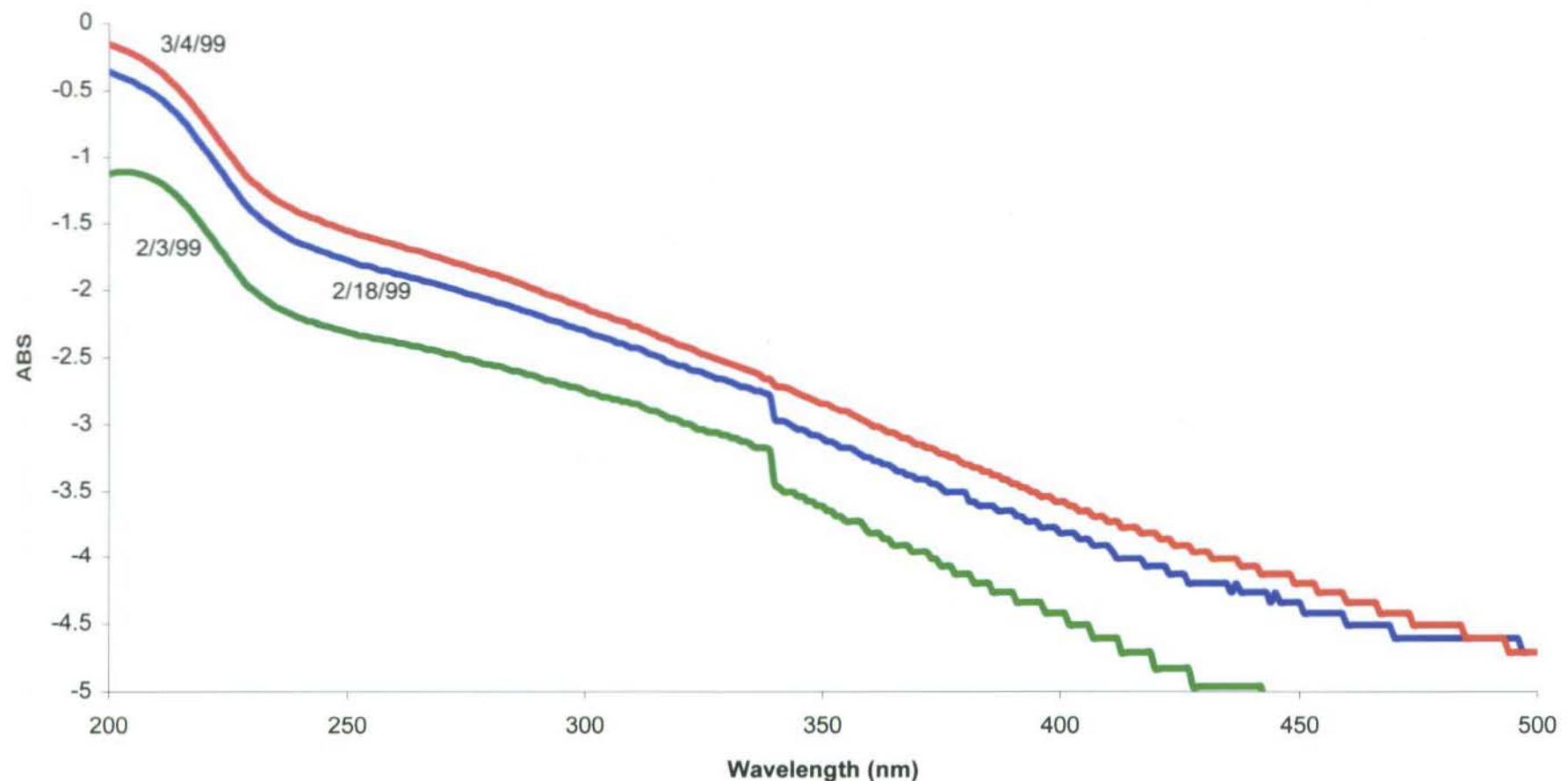
Log of Tank 6
Surface to Sediment Comparison
3/4/99



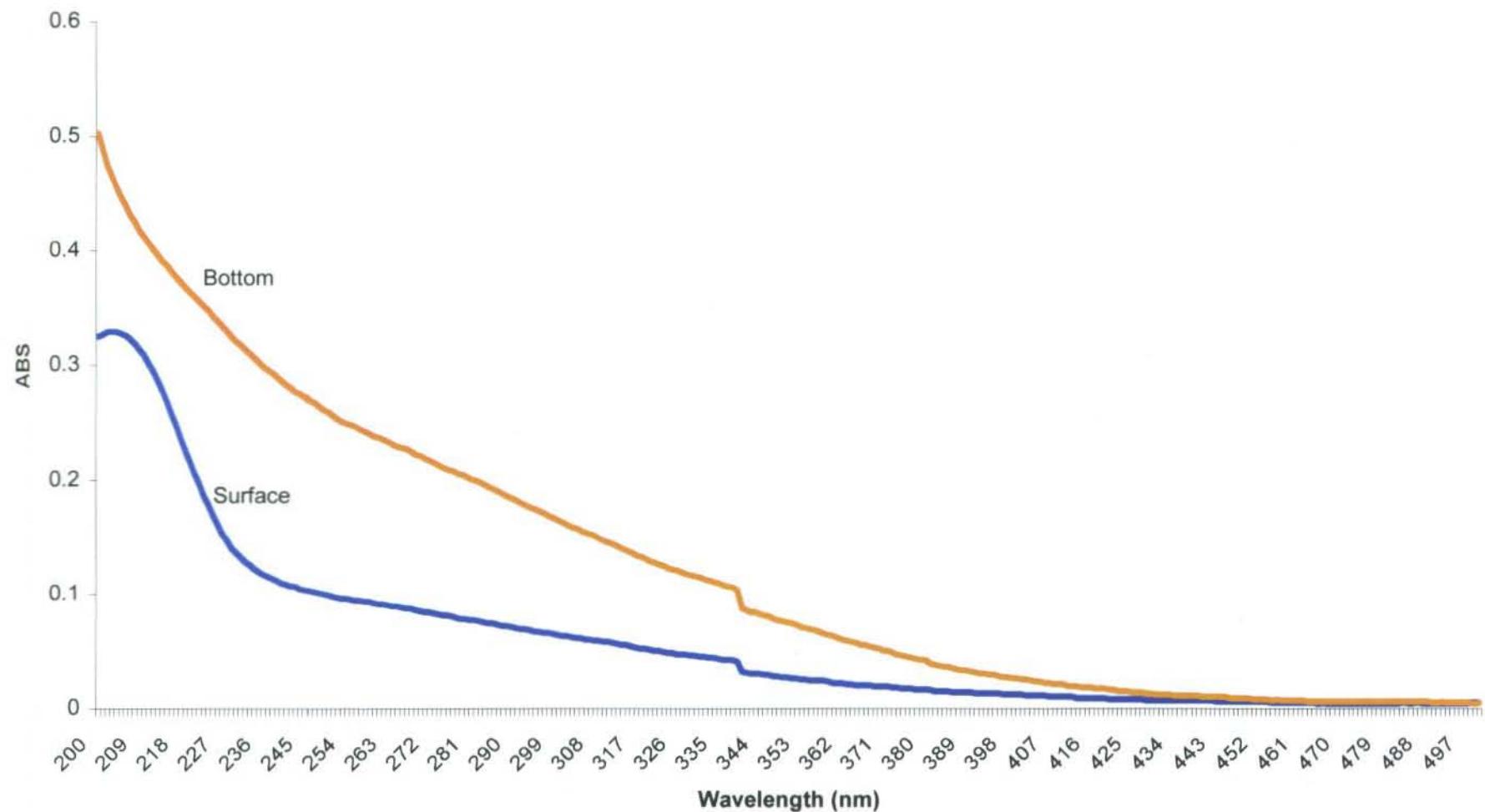
SMARTS Tank 7
Surface Water Comparison
Peat Depth: 1.5 ft
Water Depth: 7 ft
Flow: low @ stagnant



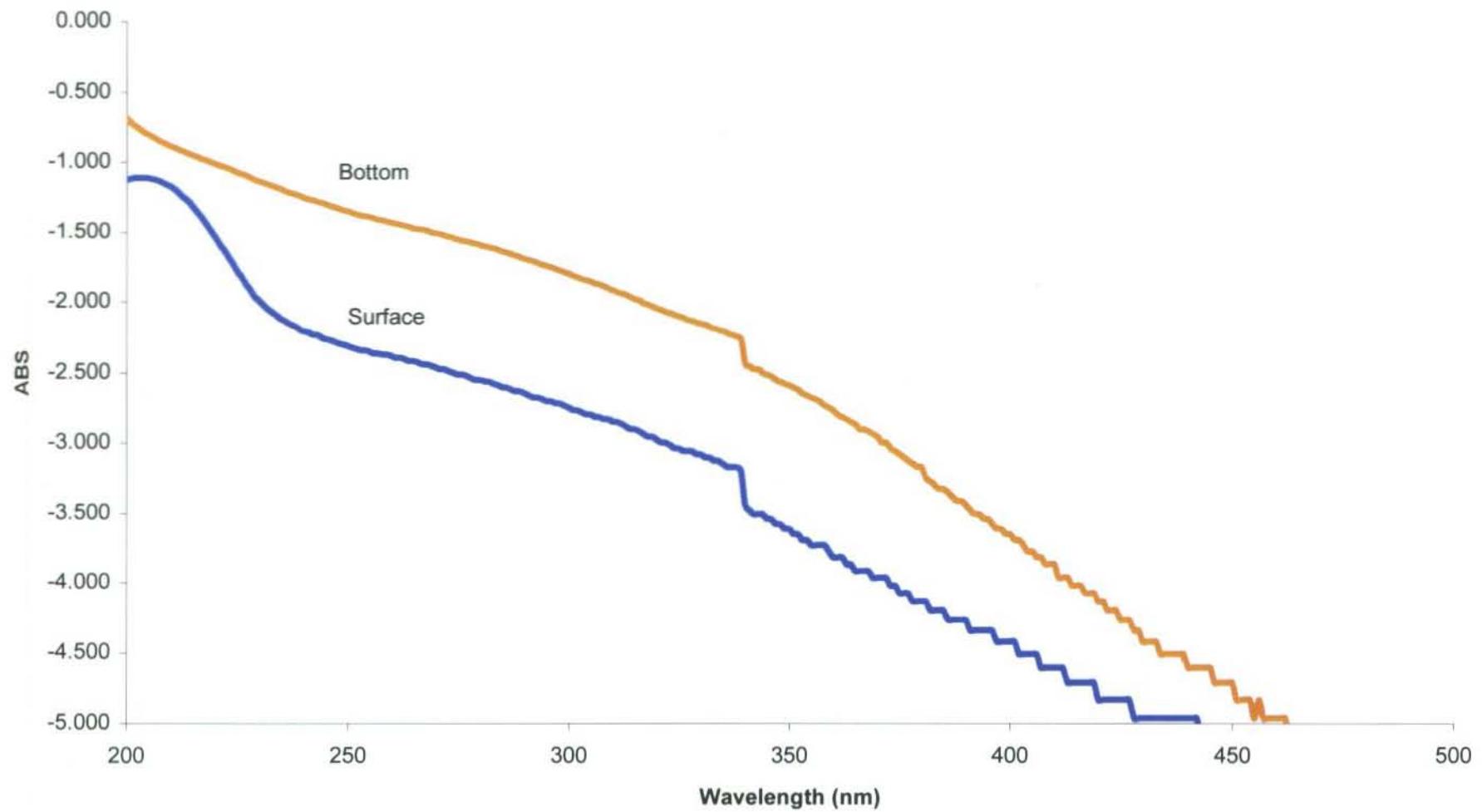
Log of Tank 7
Surface Water Comparison
Peat Depth: 1.5 ft
Water Depth: 7 ft
Flow: low @ stagnant



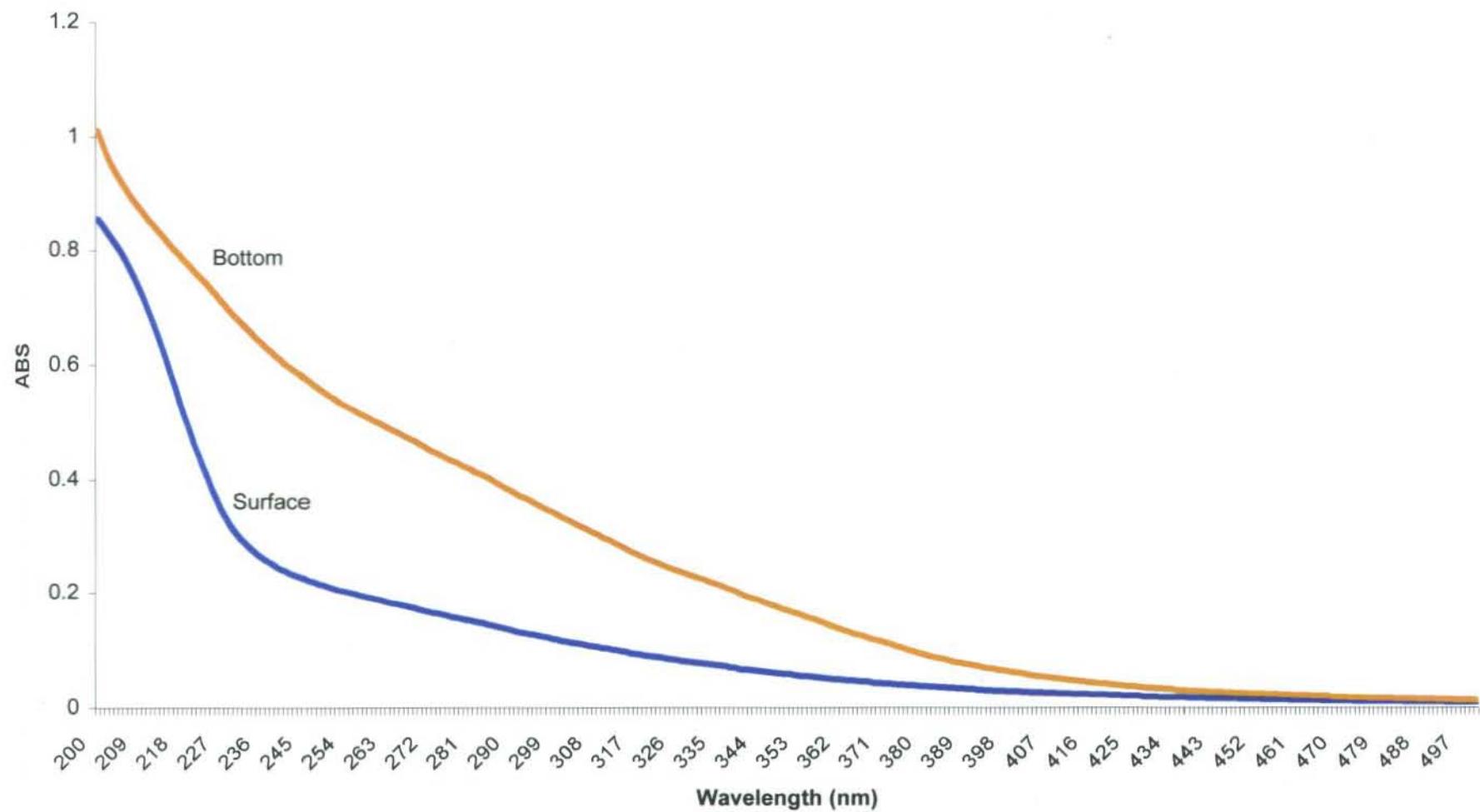
Tank 7
Surface to Sediment Sample Comparison
2/3/99



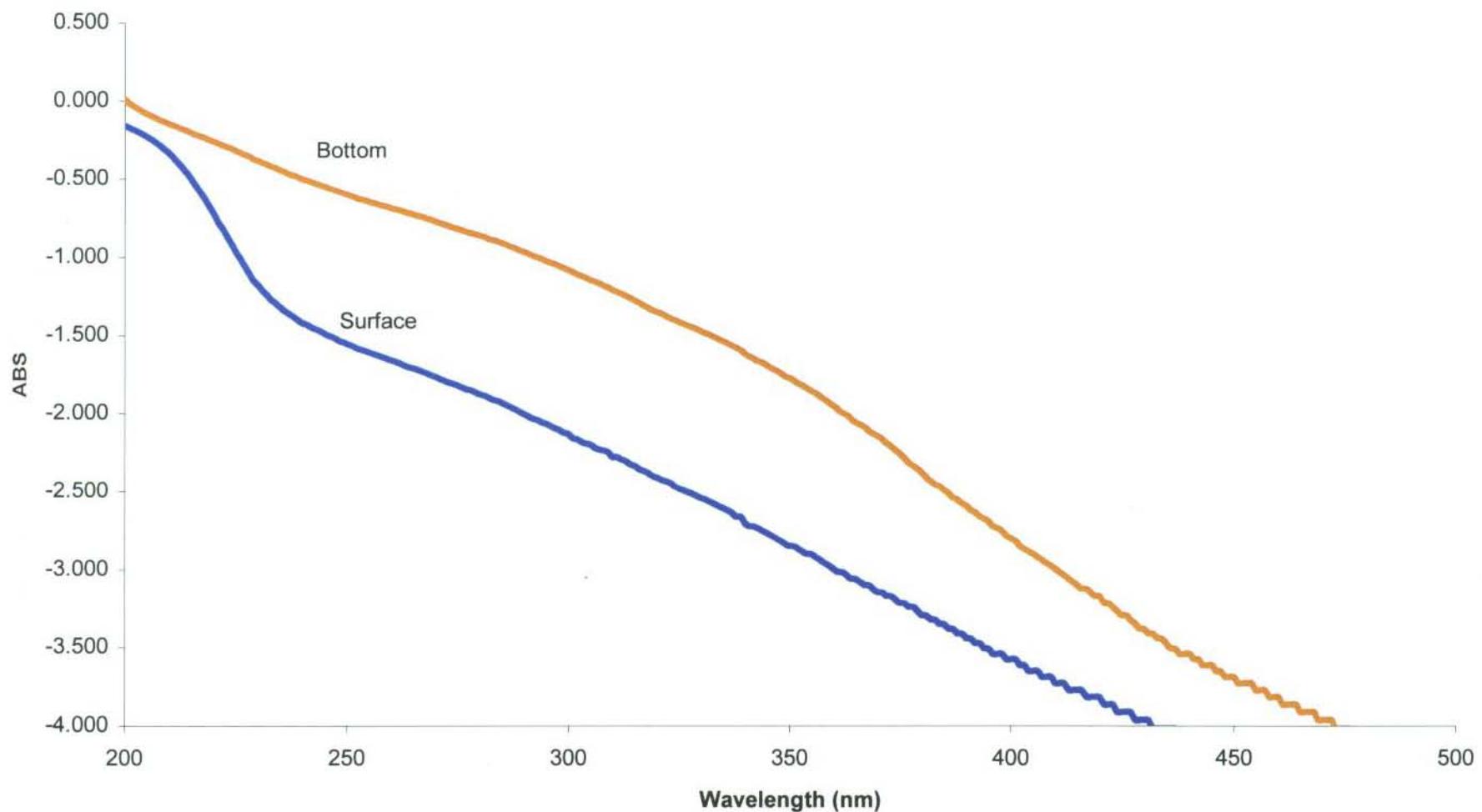
Log of Tank 7
Surface to Sediment Sample Comparison
2/3/99



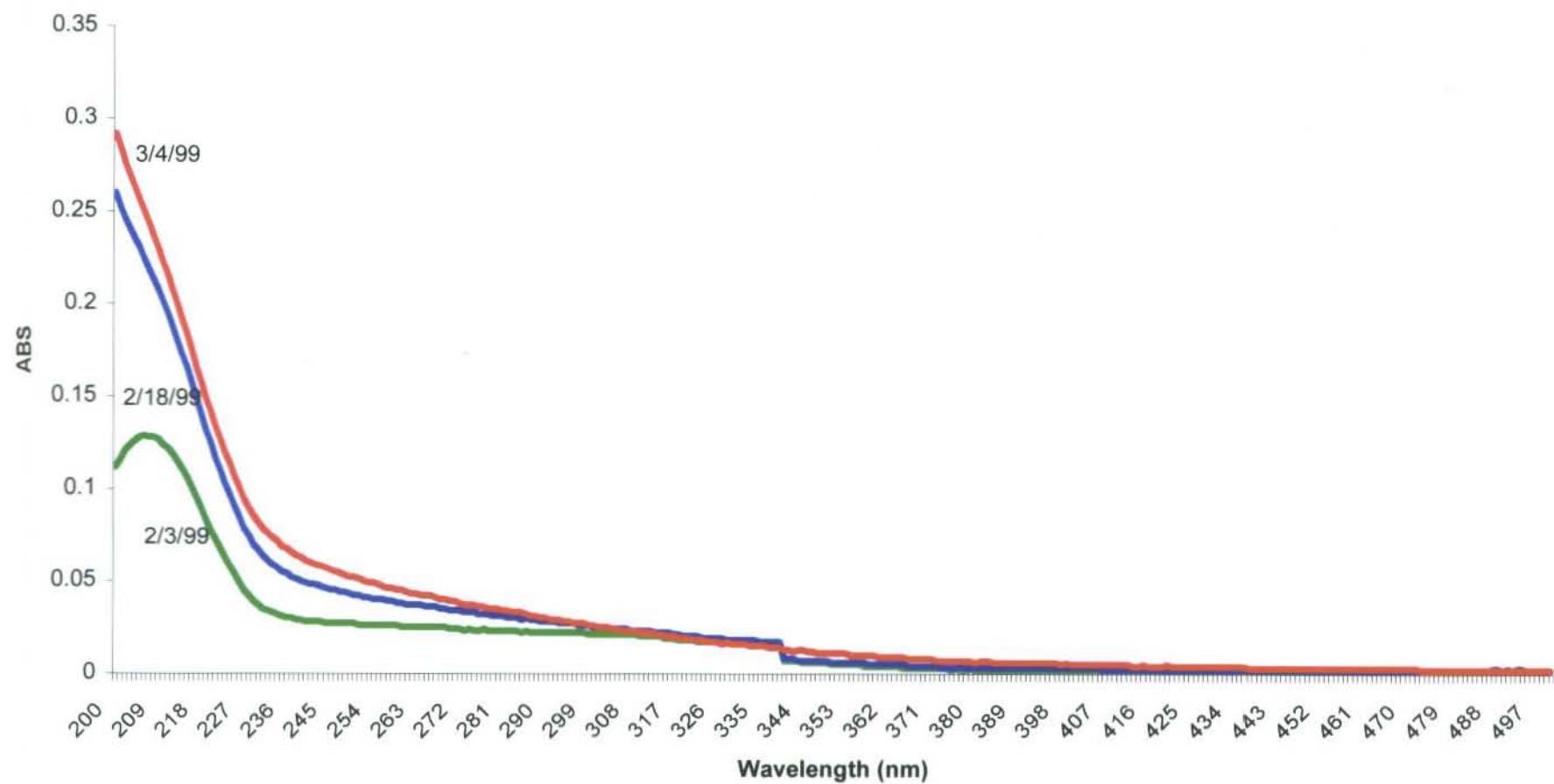
Tank 7
Surface to Sediment Comparison
3/4/99



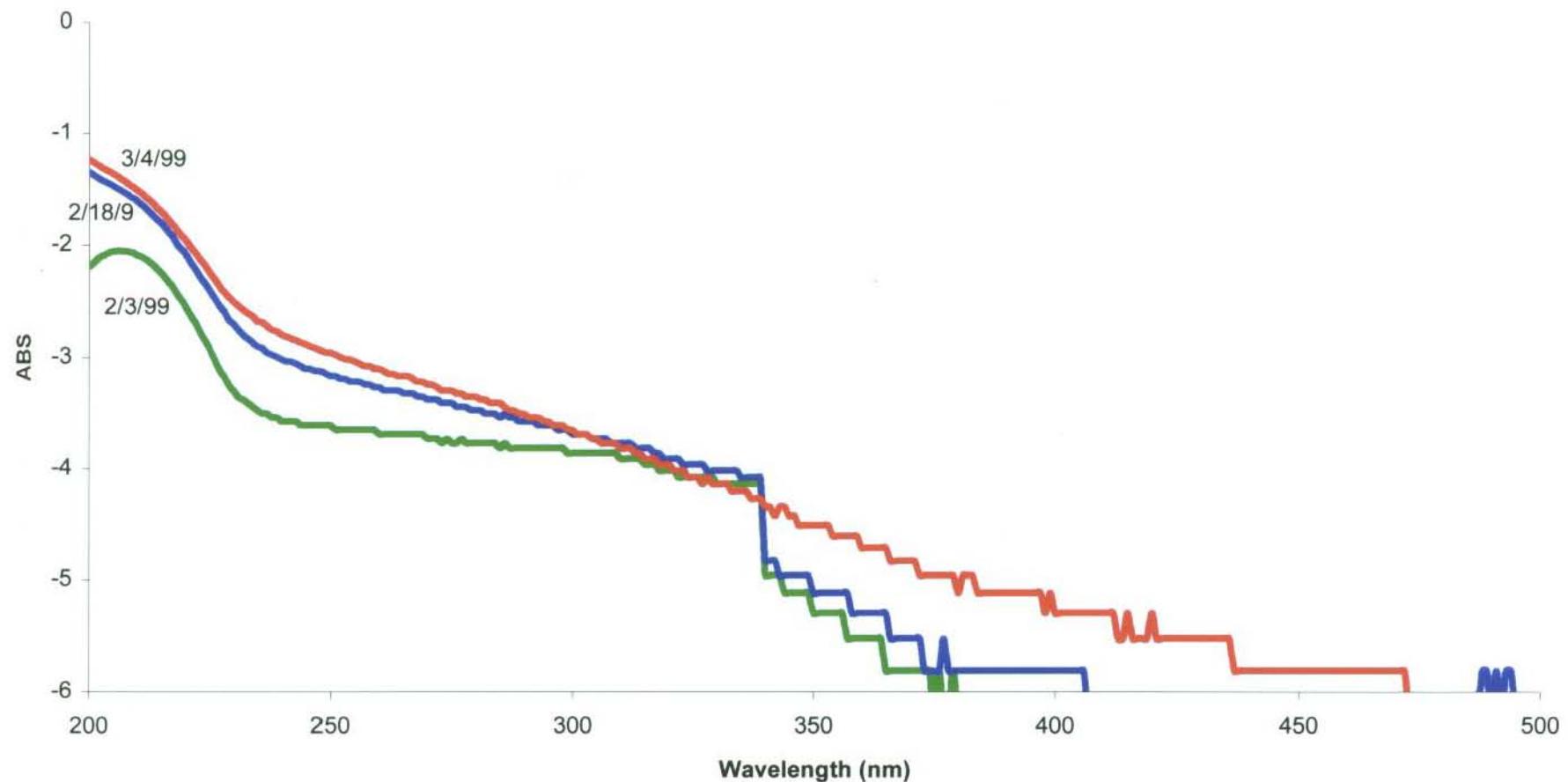
Log of Tank 7
Surface to Sediment Comparison
3/4/99



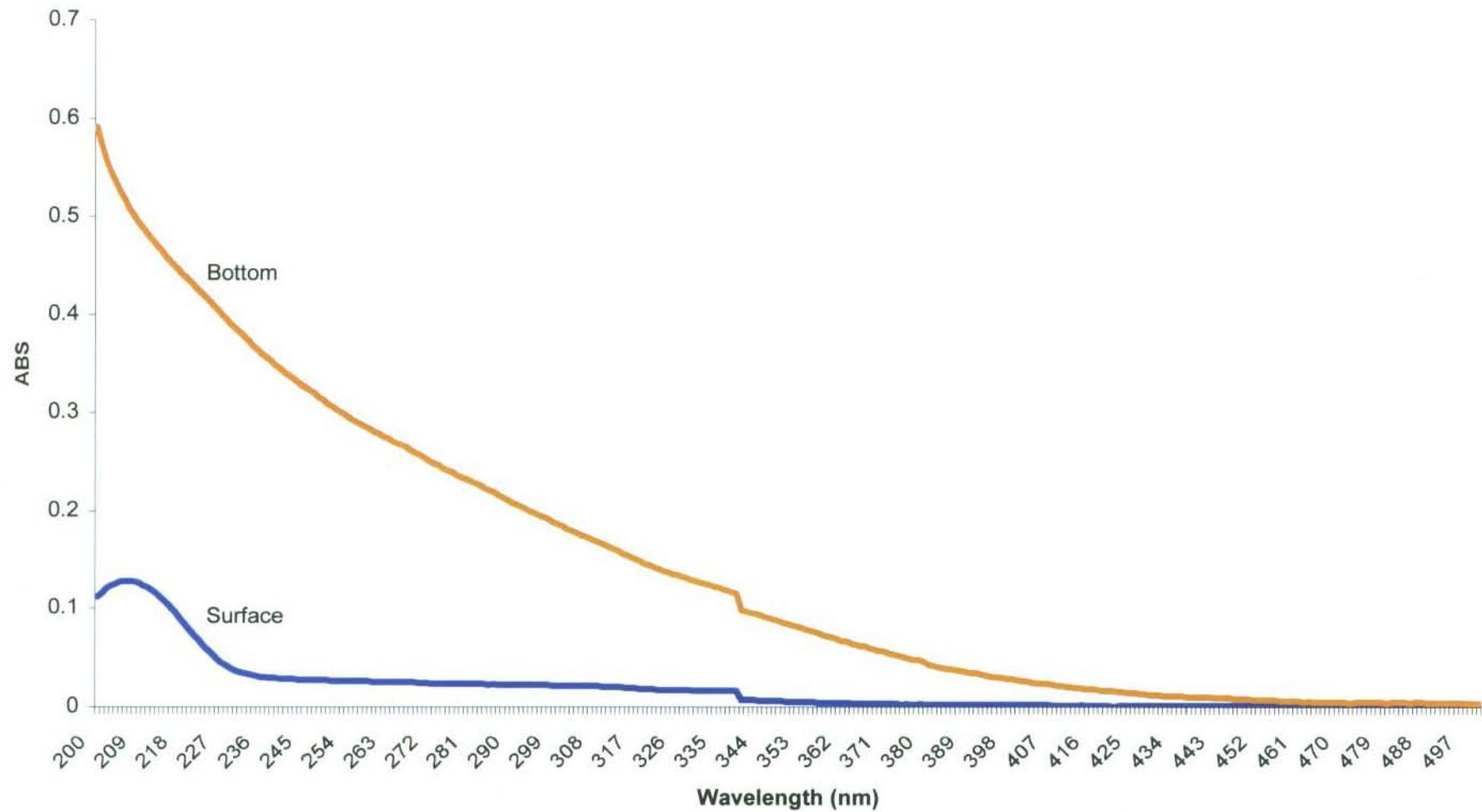
SMARTS Tank 8
Surface Water Comparison
Peat Depth: 4 ft
Water Depth: 7 ft
Flow: high @ 1 exch/wk



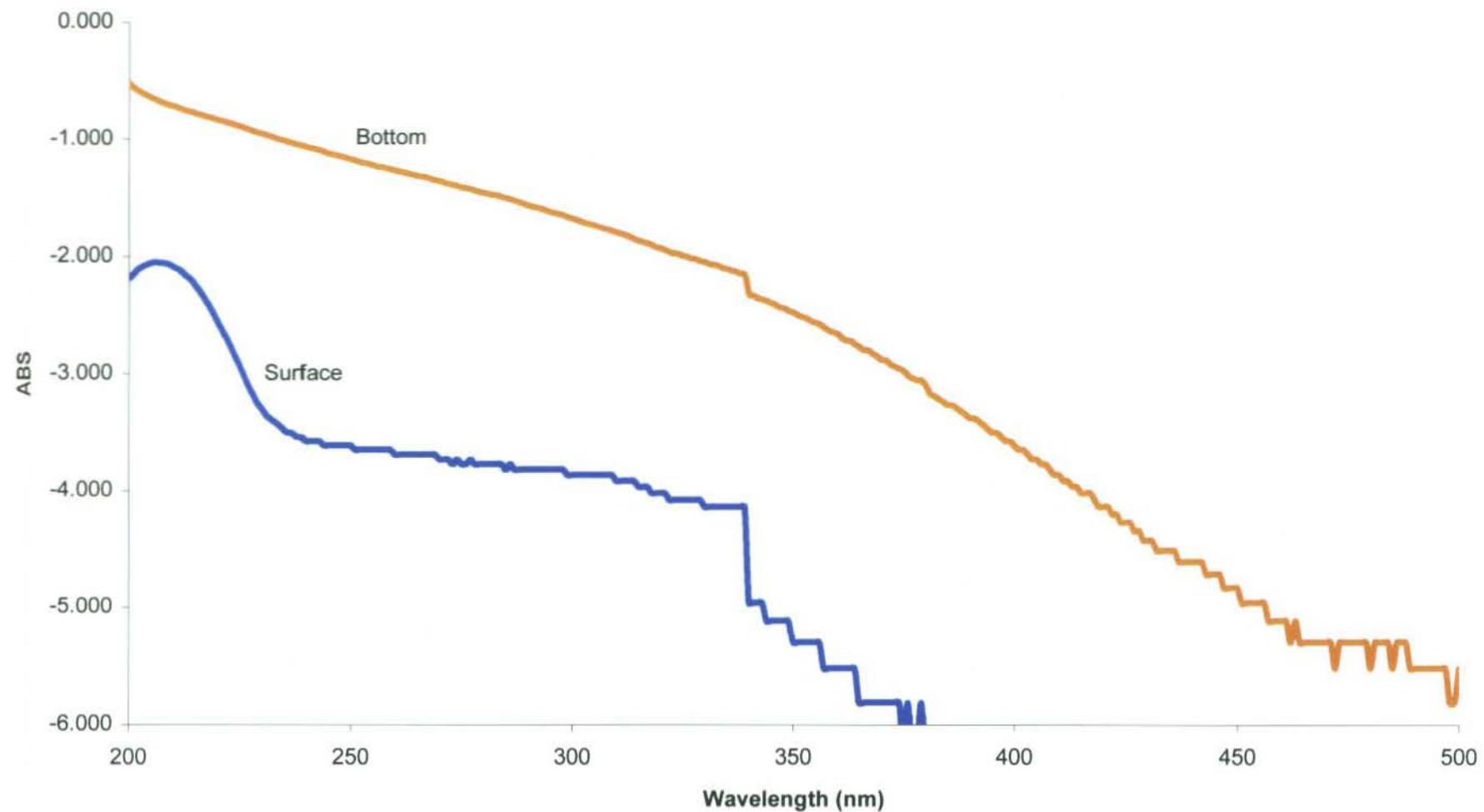
Log of Tank 8
Surface Water Comparison
Peat Depth: 4 ft
Water Depth: 7 ft
Flow: high @ 1 exch/wk



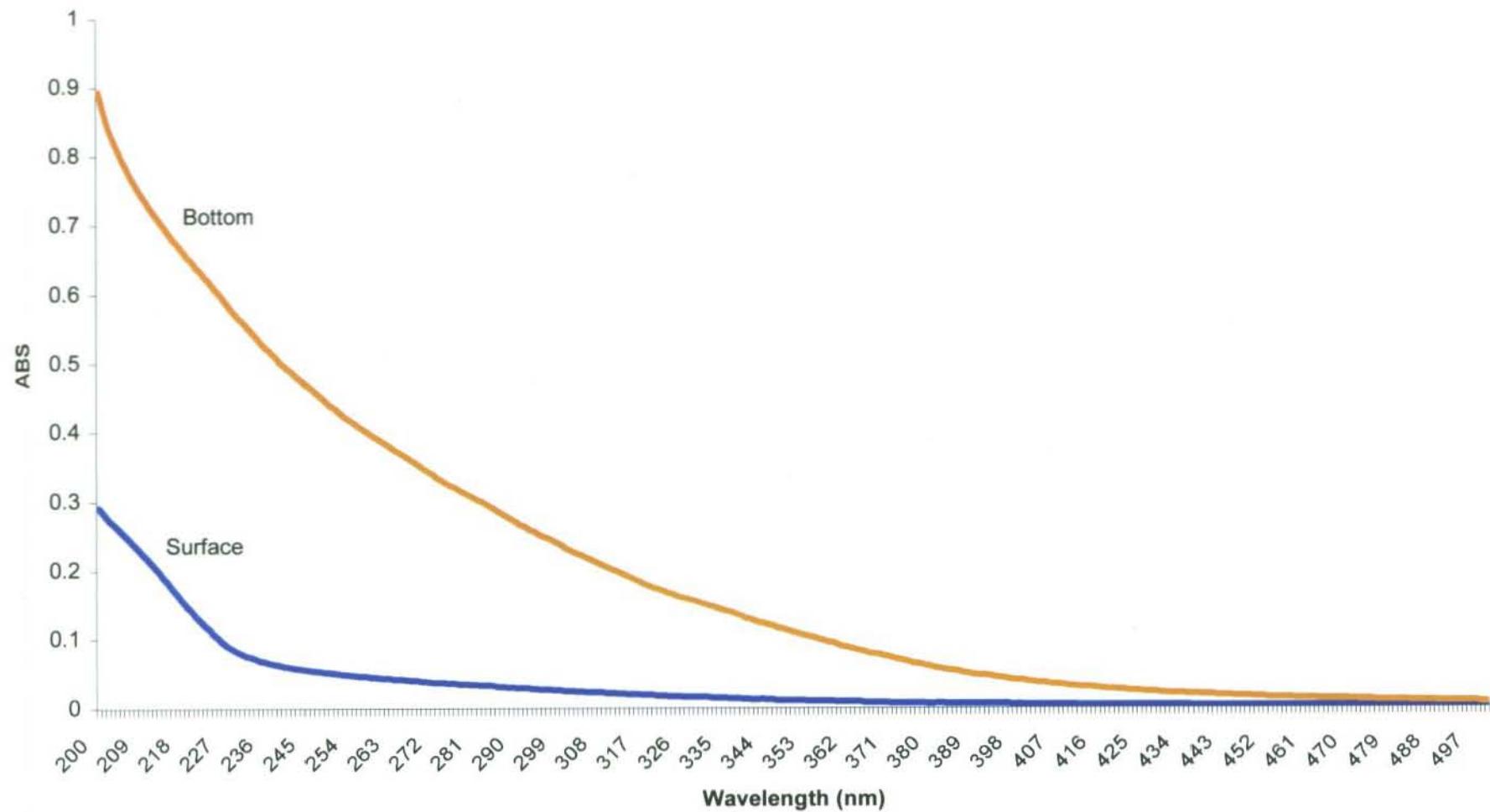
Tank 8
Surface to Sediment Sample Comparison
2/3/99



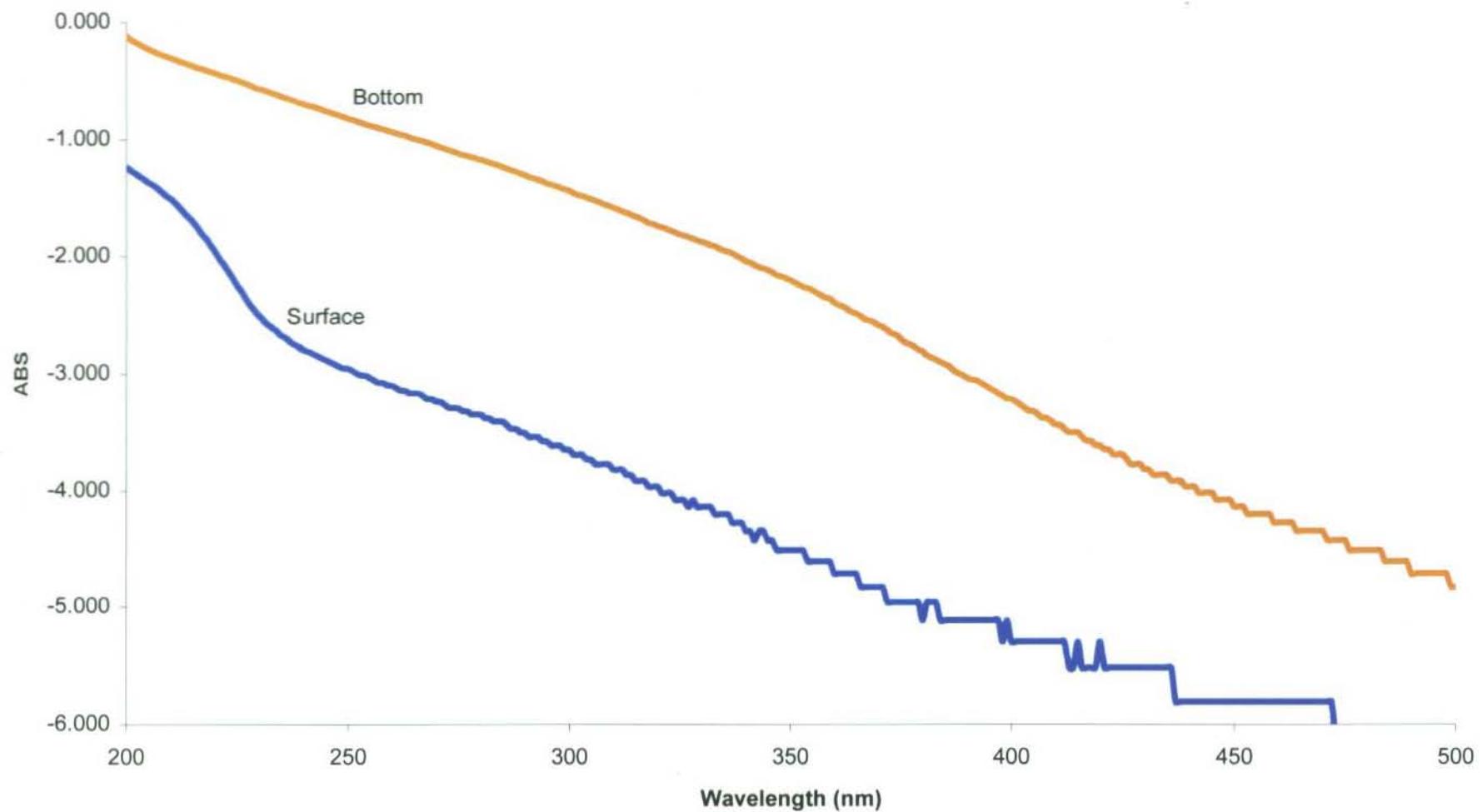
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Surface to Sediment Sample Comparison
2/3/99



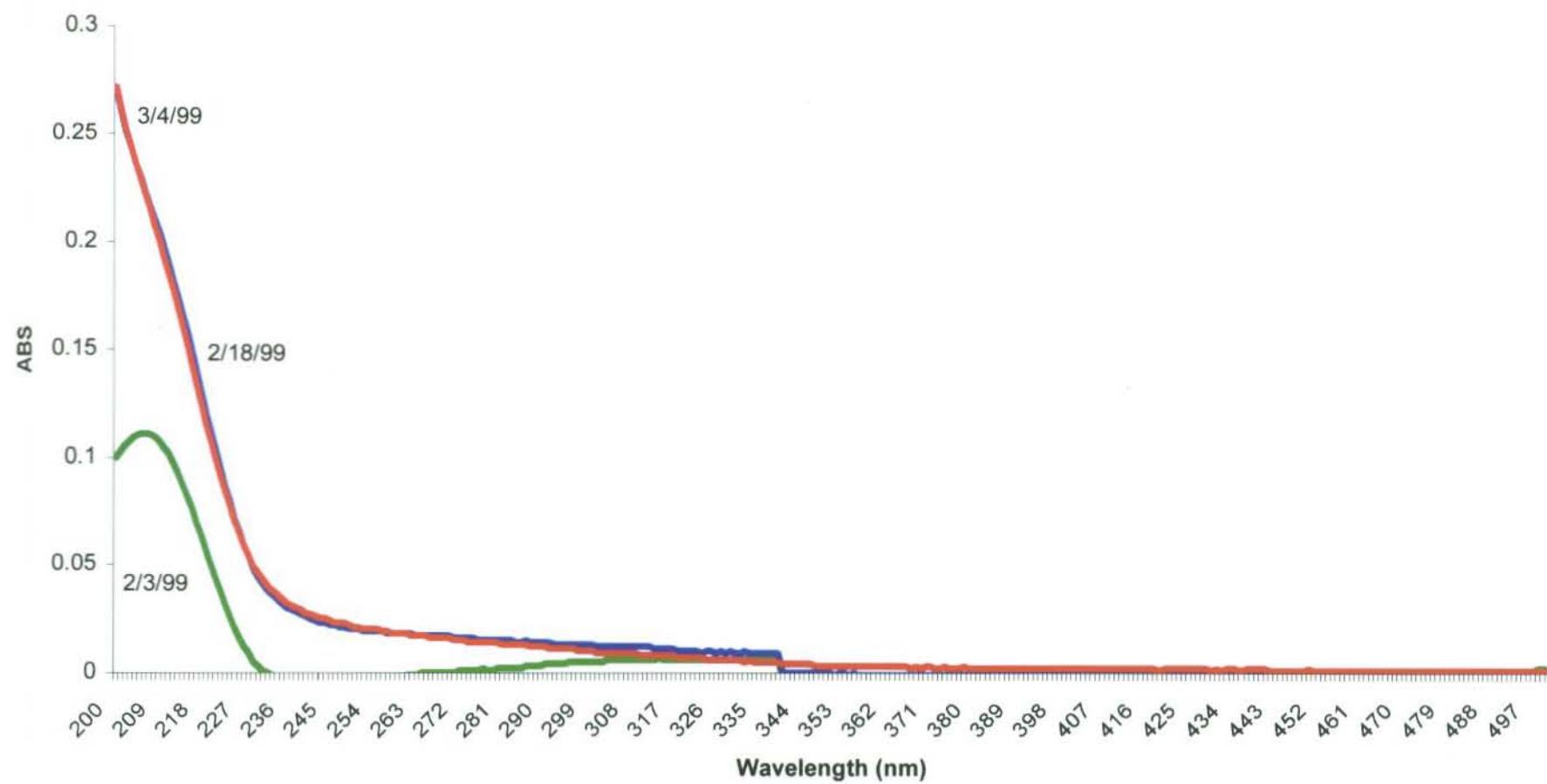
Tank 8
Surface to Sediment Comparison
3/4/99



Log of Tank 8
Surface to Sediment Comparison
3/4/99



SMARTS Tank 9
Surface Water Comparison
Peat Depth: 0 ft
Water Depth: 11 ft
Flow: low @ Stagnant



Log of Tank 9
Surface Water Comparison
Peat Depth: 0 ft
Water Depth: 11 ft
Flow: low @ stagnant

